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S. Hrg. 103–494

ECOSYSTEM MANAGEMENT

Y 4. AG 8/3: S. HRG. 103-494

Ecosystem Management, S.Hrg. 103-49...

HEARING

BEFORE THE

SUBCOMMITTEE ON
AGRICULTURAL RESEARCH, CONSERVATION,
FORESTRY, AND GENERAL LEGISLATION

OF THE

COMMITTEE ON AGRICULTURE,
NUTRITION, AND FORESTRY
UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

DEFINITION AND IMPLEMENTATION OF ECOSYSTEM MANAGEMENT ON U.S. FOREST SERVICE LANDS

NOVEMBER 9, 1993

Printed for the use of the
Committee on Agriculture, Nutrition, and Forestry

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ECOSYSTEM MANAGEMENT

TUESDAY, NOVEMBER 9, 1993

U.S. SENATE, SUBCOMMITTEE ON AGRICULTURE RESEARCH, CONSERVATION, FORESTRY AND GENERAL LEGISLATION, COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,

Washington, DC.

The subcommittee met, pursuant to notice, at 2:05 p.m., in room 332, Russell Senate Office Building, Hon. Tom Daschle, Chairman of the Subcommittee, presiding.

Present or submitting a statement: Senators Daschle, Craig and Cochran.

STATEMENT OF SENATOR THOMAS A. DASCHLE, U.S. SENATOR FROM THE STATE OF SOUTH DAKOTA

Senator DASCHLE. The hearing will come to order.

I want to thank our witnesses for changing their schedules so that we could accommodate what I expect will be a series of votes beginning at about 2:15. The hearing may have to stand in recess while those votes occur, but I am hopeful that if somebody else can be here during that time, we might be able to alternate and keep the hearing going as long as practical.

On June 4 of 1992, the Forest Service announced that it would embark on a new management philosophy that emphasizes "a higher sensitivity to all environmental values of the National Forests." However, because ecosystem management is relatively new and has yet to be clearly defined, questions have been raised as to how it specifically will affect the stewardship of Federal lands.

For example, it remains unclear how the implementation of the ecosystem management will affect the development of new forest plans or the standards and guidelines used to govern the harvesting practices in our national forests and whether the Forest Service will perform the research necessary to develop sound ecosystem management strategies for all the national forests. These questions need to be answered if all those affected by management of the national forest can be comfortable supporting this approach.

One thing is certain: the time has come to take management of the national forest in a new direction.

Public criticism of the Forest Service has grown in recent years. Over harvesting and the use of questionable forest management practices have eroded public confidence in the agency. Environmental groups continue to file numerous appeals and lawsuits, charging failure to comply with basic environmental legal requirements.

The Forest Service has been forced to hire more and more wildlife biologists to ensure that timber sales do not further harm sensitive species. Timber-dependent communities suffer as National Forest timber programs are paralyzed. Costs have gone up. Species have been put at risk and timber sales have been held up.

Federal land management agencies are responding by changing the way they do business. In June of 1992, the Forest Service took the first step toward implementing more ecologically sensitive stewardship of Federal land. This summer, USDA Assistant Secretary Lyons stated that the Forest Service is no longer "going to manage for predetermined timber sale targets anymore. We are going to manage to protect the health of forest ecosystems," he said. "Timber management will continue to be an important product of forest management, but we need to look at timber as a tool of forest management, as opposed to its sole objective."

This statement signals an important shift in direction. It reflects the future of Federal policy. But as we move in this new direction, policy makers must not only respect the biological limits of national forest ecosystems, they must not forget that people and communities are integral parts of these ecosystems and their needs must be accounted for in this new process.

Americans share a common interest in ensuring that the Federal lands are managed in the most responsible manner, so that they may be enjoyed in perpetuity by our children and their children. I am hopeful that ecosystem management will provide the means to achieve truly outstanding stewardship of our natural resources. If together we forge this new system of management, then I believe we can move beyond the appeals, the litigation, and the debates over below cost sales and focus our efforts on providing a reliable supply of timber while managing the national forests in the most ecologically responsible manner possible.

Today we are holding the first of two hearings on the subject of ecosystem management. We intend to examine the progress of the Forest Service and the Bureau of Land Management in defining, developing and implementing ecosystem management.

Of particular interest to the subcommittee is whether Forest Service and the BLM are committed to performing the research necessary to develop sound ecosystem management strategies for all Federal lands, how the Forest Service and the BLM will be coordinating with other Federal agencies, and how implementation of the ecosystem management will affect Forest Service planning and timber harvesting practices.

We intend to hold a second ecosystem management hearing early next year to explore issues of private land ownership, whether the existing Federal laws are adequate to allow the Forest Service to implement ecosystem management, and whether the current Forest Service budgeting system needs to be revised to give the Forest Service more flexibility.

I want to thank all of the witnesses for their attendance this afternoon and it is perfect timing, but I would call upon my ranking member for any opening comments that he wished to make.

STATEMENT OF SENATOR LARRY E. CRAIG, U.S. SENATOR FROM THE STATE OF IDAHO

Senator CRAIG. Mr. Chairman, let me thank you very much for holding these hearings, and as we discussed early on, some of the issues that might become priority issues before this subcommittee, and to discuss the whole general issue of ecosystem management. You were very willing to explore that. This administration is referencing that. It becomes reality in the Forest Service as they look toward implementation of some of these concepts in their management schemes now and over the last year or so.

I think all of us on this committee who have large public lands in our States have watched with a very high level of frustration the head-on that public policy is now taking in a collision course with itself. We see the frustration of foresters or BLM people, and range managers with the Endangered Species Act as it relates to a variety of other policies. We have heard Secretary Babbitt speak eloquently to the National Biological Survey as his approach toward dealing with the Endangered Species Act and ecosystem management.

There are a lot of questions to be asked. But more importantly I think, Mr. Chairman, it is clearly the responsibility of the United States Congress, in working with this administration, to try to resolve the obvious train wreck that I believe not only are we heading toward, but I believe in reality we are in.

Idaho is quite typical of the Western States in that we are highly dependent upon access to our public land resources for all reasons. From a sound and quality environment for recreation purposes, for a tourism economy, for well-being of the state of mind that exists there, but also for the traditional economies of the forest products industry and the thousands of people that are employed by it, and the livestock industry and the mining industry.

There remains an attitude by some that the best way you manage this public land and its resources is to get people off and away from it. And that, of course, in its essence destroys the economies of the west and does not resolve anything. Many of us have always felt there has to be a better way.

But the question becomes, and I hope we can explore it in this committee, the relation of ecosystem management, with the National Forest Management Act, and with the Federal Land Policy and Management Act. There are so many questions to be asked and decisions to be made. If, in fact, ecosystem management is a reality, should it be written into law? That is a question that ought to be asked, and we ought to have a full discussion as it relates to dealing with it in that regard.

I think all of us are frustrated by the fires of California of recent days. One of the things that was not mentioned, but it was very significant at least to some, was that a large portion of the habitat designated for the gnatcatcher was destroyed. Is that not a conflict with where we are?

We know that those areas in California have historically burned time after time after time. And yet, somehow a habitat was maintained there. It does not speak well to our intelligence or our capabilities. But we are driven by politics. We are driven by policy, and yet, it appears that some of the directions we are headed in do not make a lot of sense.

Clearly, in the Western States today, the public land States, where there can be tremendous influence placed by public policy, the whole issue of the Endangered Species Act and what it means, and the idea of single management packages for every single species that is designated as endangered or at risk through the Endangered Species Act, just cannot make sense, Mr. Chairman.

We cannot manage that way. We cannot have hundreds upon hundreds of management schemes all stacked on top of each other, colliding with each other, requiring very specific management demands on staff and time of the agencies. The idea that it would take upwards of several millions of dollars for every management scheme, and there are hundreds that would be suggested, well that is why we are holding the hearings. That is why you and I and others are increasingly interested in looking at issues to be dealt with.

I brought with me a copy of this publication called Snapshot in Time, which compares historic photographs of the Boise National Forest with 1992 photographs of the same terrain. The difference in vegetative cover are very, very dramatic, largely as a result of wildfires.

So I hope that through the process that we are about to engage in, Mr. Chairman, we will use our talents, our capabilities, the unique ability to use computer modeling to look forward and look backwards and evolve a public policy that blends all of our interests together in a realistic fashion towards managing our public lands.

Conflict does not work. It only damages the very thing we are interested in protecting or managing in a reasonable fashion. I hope that we can move ahead. Thank you.

Senator DASCHLE. Thank you very much, Senator Craig.

[The prepared statement of Senator Craig follows:]

STATEMENT OF SENATOR CRAIG

Senator Daschle, thank you for holding this hearing, and for the spirit of cooperation which has gone into preparing for the hearing.

Ecosystem management is a very timely topic for the subcommittee. It is the subject of frequent discussion in a variety of contexts related to forest policy:

- Its relationship to the Endangered Species Act and the species-by-species approach it mandates.
- Its relationship to the National Biological Survey. Secretary Babbitt has argued that creation of the National Biological Survey will support the development and implementation of Ecosystem Management. I am interested how this is to be accomplished.

Its relationship to the National Forest Management Act (NFMA). Former Forest Service Chief Dale Robertson adopted Ecosystem Management as policy in June 1992. However, compatibility of ecosystem concepts with the procedural requirements of NFMA is still unclear to me.

Its relationship to the Federal Land Policy and Management Act (FLPMA). The BLM is developing its own Ecosystem Management policies. Coordination and consistency among the agencies warrants further discussion during this hearing.

There exists widely-held expectation that Ecosystem Management holds the key to solving our divisive public debate over natural resources. Despite all the interest, there is much about it we do not understand. This hearing on its policy and research aspects, and a later hearing on its implementation, should help us better understand its promise and its problems.

Ecosystem Management may have the potential to rally divergent public opinion around common goals. But I suspect significant changes in law, regulation, and budgeting procedures will be needed to make it work.

For instance, species-by-species protection required by the Endangered Species Act conflicts with my understanding of Ecosystem Management objectives. Ecosystem Management should strive to provide broad habitat conditions which benefit many species of plants and animals. Exclusive emphasis on one species may force the decline of others. The result is a management dilemma of overlapping and conflicting recovery plans.

We must remember that nature is not static. Wildfire, insect infestations, and hurricanes are a few of the forces which periodically alter the landscape. Habitat set-asides for individual species are a fragile solution. As we've recently witnessed in the case of the southern California fires, a significant portion of habitat designated for the gnatcatcher was destroyed. The lesson we should learn is that ecosystems must be actively managed, and that principle is the same whether in California chaparral or Idaho mixed conifer forests.

To illustrate this point further Senator Daschle, I've brought with me a copy of the publication "Snapshot in Time" which compares historic photographs of the Boise National Forest with 1992 photos of the same terrain. The differences in vegetative cover are dramatic—largely as the result of wildfire.

Through our hearings process, I hope we will:

- Expand our understanding of the potential of ecosystem management.
- Determine how it can be applied to assist natural resource managers solve the complex issues they face today.
- Commit to developing the new legislative and scientific tools needed to support the orderly application of ecosystem management in the field.

Senator DASCHLE. We have a vote, but Senator Craig and I both have a 4:30 conflict that will necessitate that we try to finish this hearing prior to 4:30. To accommodate that schedule, I would like to call our Forest Service and BLM witnesses to the table and begin testimony at this time.

Mr. Dave Unger, the Acting Chief of the Forest Service is here, and Mr. Jim Baca, the Director of Bureau of Land Management, who is accompanied by Dr. Jack Williams. If they would come to the table, we will take their testimony. We have 15 minutes to the first vote, then there will be two accompanying votes. I think we may just stay for the second two votes and then be right back.

Senator CRAIG. Mr. Chairman, let me also welcome Jim and Dave and also congratulate Dave for his new role, obviously a very demanding one. I wish you luck.

Mr. UNGER. Thank you.

Senator DASCHLE. No truer words ever spoken. You have a big job ahead of you under difficult circumstances and we appreciate your willingness to come today and appear with the BLM. We will take your testimony at this time, Mr. Unger.

STATEMENT OF DAVID G. UNGER, ACTING CHIEF, U.S. FOREST SERVICE, WASHINGTON, DC; ACCOMPANIED BY DR. FRED SWANSON, SUPERVISORY RESEARCH GEOLOGIST AND ECOSYSTEM TEAM LEADER, PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, CORVALLIS, OR

Mr. UNGER. Thank you, Mr. Chairman. We appreciate the opportunity to talk about our ecosystem management strategies on national forest system lands. I am accompanied by the gentleman at the end here, Dr. Fred Swanson, who is a supervisory research geologist and ecosystem team leader from our Pacific Northwest research station in Corvallis Oregon.

As the chairman has mentioned, in June the Forest Service did announce ecosystem management as a framework for managing the national forests and grasslands. As you know, this followed a two-year experiment with what we call new perspectives, which sort of laid the groundwork for the principles that we later announced in this ecosystem management initiative.

Let me try to define in a couple of different ways what we think ecosystem management is. We believe it is a holistic approach to natural resource management that moves beyond a compartmentalized approach. The compartmentalized approach focuses on individual parts of the forest and we want to look more comprehensively. It is an approach that steps back from the forest stand and focuses on the forest landscape and its position in the larger environment in order to integrate the human, biological and physical dimensions of natural resource management.

I summarize it by saying it means considering the whole fabric of our natural resources as we make decisions, understanding, and preserving the vital connections between land, water, wildlife, vegetation, and human beings, and assuring that we provide the values, the uses, products, and services desired by the public in a sustainable manner. Comprehensiveness, connections, change, and sustainability are the watchwords of ecosystem management.

The scientific basis for ecosystem management is provided by our Forest Service research organization and cooperating scientists from other institutions. We believe an enhanced scientific underpinning is fundamental to taking an ecosystem approach to managing our resources on a sustainable basis.

Our research strategy concentrates on understanding ecosystems where we try to understand the makeup and function of forest and grassland ecosystems. Two key components of this are to look at ecological trends, including major disturbance factors to estimate past and future conditions, and then to monitor the results of management activities in order to ensure that the predicted conditions are achieved.

The second focus of research is working toward understanding people and natural resource relationships more adequately. We want to learn more about how people perceive and value the protection and management in use of natural resources because we recognize that people's needs and uses and attitudes affect all forest and range resources.

Thirdly, our research will focus more on understanding and expanding resource options. This has the goal of looking at stewardship practices and utilization systems that protect and enhance long-term resource productivity and biological diversity.

Let me say a word about cooperation. I think it is evident to everybody that because ecosystems cross so many boundaries, administrative, political and other boundaries, many Federal, State and county agencies, tribal governments, private landowners, community leaders, corporate foresters, a whole range of people are interested in ecosystem management. We recognize the sensitivity of private property rights and the questions about how ecosystem management can be implemented across property boundaries. We believe cooperation is the key to success in this regard.

In our State and private forestry work, our objective is to provide technical and financial assistance to Federal and State land managers and to nonindustrial private landowners. All these programs are voluntary, they are carried out in accordance with Federal, State and local laws, and actual decisions on resource management are left to the landowner.

Now let me take a few minutes to describe some changes that are underway in the Forest Service as we begin to implement ecosystem management. First, we have adopted an ecological unit framework to provide a scientific basis for ecosystem management. This is a classification and mapping system for stratifying areas across ecological units that have common biological and environmental factors.

This is hot off the press and I brought along a copy to share with the committee.

Senator DASCHLE. Thank you.

Mr. UNGER. Second, we have completed some major regional ecosystem assessments. We are beginning some others, and we are setting out the parameters for still others. Examples of this are our participation, along with many others, in the FEMAT report for the Pacific Northwest and Northern California spotted owl forests, and the Eastside Forest Ecosystem health assessment for eastern Oregon and Washington that was prepared.

We are working together with the Bureau of Land Management in a cooperative strategy for protecting the habitat of Pacific salmon and steelhead known as PACFISH. Another beginning is the Sierra Nevada study in California. A number of these larger, broader, more comprehensive assessments of information that can later be used for forest planning and for decisionmaking.

We are following ecosystem management in many on the ground projects. In my testimony, I have just mentioned a few of them, the White River initiative in Vermont, the Hurricane Hugo restoration project in South Carolina, the Cicero Fire Recovery French Creek Fisheries project in South Dakota, the blackbark beetle thinning in Oregon, and the Butte Valley National Grassland project in California. There are many others that have been developed in recent years; some as demonstration projects under new perspectives and others as we begin to incorporate these principles in our ongoing work.

Let me say a word about collaborative efforts. We believe a wide variety of partnerships involving managers, universities, other agencies, and the public at large are going to be really important as we proceed with ecosystem management. We have tried to strengthen our working relationships in recent times with other agencies, including the Soil Conservation Service, the Bureau of Land Management and other agencies in Interior, and the Environmental Protection Agency. We are actively engaging ideas on how to better coordinate our policies, how to share information, and standardize information across administrative boundaries.

Senator DASCHLE. Mr. Unger, I see we have about five minutes left on this vote. So if I do not recess now I do not know that we will make the vote. Why don't I stop and we will resume just as soon as we get back. It will be about 15 minutes.

[Recess.]

Senator DASCHLE. The hearing will come to order.

We had more votes than we expected, and so it has obviously taken a lot longer than we had anticipated. Dave, if you will continue, we appreciate your patience and indulgence and would invite you to finish your testimony at this time.

Mr. UNGER. Thank you, Mr. Chairman. I only have a couple of points and I will conclude.

I would just like to mention that we are looking at several areas where we may need to change our policies to implement full ecosystem management. There may be areas where changes in the existing statutory framework would be desireable. We do know that we would need to change our regulations to streamline our land management planning process. This is a process that we have had underway for some time and we have evaluated it after the first round of forest plans, and we want to strengthen it and base it upon ecosystem management principles. We hope to propose those regulatory changes early in calendar year 1994.

I would just like to conclude by saying we do not see any final system for ecosystem management in the future because we believe this is an evolutionary process. It is not something that was done one way before, and then all of a sudden we agreed to do ecosystem management and then everything changes instantly. It has been building on lessons we have learned in the past. It will build on lessons that we build on in the future. We think that a really key element of ecosystem management is a consistent monitoring effort, so that we can look at what we do, evaluate it, make changes, and improve our management as a result of that monitoring and incorporate new information from that monitoring from the public and from the scientific community.

So I will conclude with that and try to answer any questions you have.

Senator DASCHLE. Thank you very much. The BLM, of course, is here as well on the first panel. We would like to welcome Jim Baca, the Director of the Bureau of Land Management. Jim, you have waited a long time and we appreciate your testimony.

STATEMENT OF JIM BACA, DIRECTOR, BUREAU OF LAND MANAGEMENT, DEPARTMENT OF INTERIOR, WASHINGTON, DC; ACCOMPANIED BY DR. JACK WILLIAMS, SCIENCE ADVISOR, BUREAU OF LAND MANAGEMENT, DEPARTMENT OF INTERIOR, WASHINGTON, DC

Mr. BACA. Thank you, Senator. It is a pleasure being here.

I guess I would just add that ecosystem management as a concept has been underway at BLM for about two years. Certainly Secretary Babbitt has made it a pivotal instrument for land and resource management by the Department of the Interior. It is going to be our new American land ethic.

The BLM has enthusiastically adopted this principle and we will work diligently to try to make it work on our 270 million acres of public lands and on our mineral estates.

Senator the word ecosystem clearly implies some form of a geographic delineation, one that crosses jurisdictional lines, geopolitical boundaries by which we have managed our lands and resources in the past. The backbone of our management approach will be the setting of common goals and developing consensus amongst diverse interests. These goals must be developed within the limits imposed by sustainability of natural systems if we are to ensure long-term viability of our resources and our economy.

The BLM views ecosystem management as the integration of ecological, economic and social principles to manage lands and resources in a manner that safeguards long-term ecological sustainability. The primary goal of ecosystem management for the BLM is to develop management strategies that will maintain and restore the ecological integrity, productivity and biological diversity of our public lands. Among other things, sustainable ecosystems provide high quality habitat for fish and wildlife, clean drinking water for communities and economic and recreational opportunities.

In the past, BLM's resource management placed emphasis on commodity production and the sale of natural resources. Management objectives were generally designed to expedite the development, extraction and production of resources on these public lands. Other uses and values, such as wildlife and fish, some recreational activities, cultural, scenic and aesthetic resources were often viewed as adjuncts to what we did.

The lack of the broad view encompassed by ecosystem approaches has led to increased sedimentation in streams; less productive rangeland conditions; fragmented plant, animal, and fish habitats; and forest health problems. Population growth, increased use, and other factors, have also contributed to the degradation of the public lands and caused significant declines in the distribution and populations of many native flora and fauna.

Many communities whose economies depend on public lands are affected because an ecosystem approach was not used. The declining timber and fishing industries of the Pacific Northwest, for example, demonstrate the economic repercussions and social displacement that can accompany ecosystem degradation.

Conservation efforts on public lands make a critical difference to the viability of vulnerable plant and animal species and on the stability of local economies. Unfortunately, poor forest and rangeland health and degraded riparian areas, and inferior aquatic habitats often threaten species' viability, resource productivity, and ultimately, the overall sustainability of ecosystems.

Because of such conditions and impacts to the public lands, we must take a holistic approach. Under ecosystem management, the BLM will manage the public lands to sustain viable ecological processes and functions. We intend to conserve, maintain, restore and enhance the ecological integrity of the land and its resources while providing for human values, products, and services and assuring ecological sustainability.

We are going to have to form partnerships to identify and achieve healthy, fully-functioning conditions on these public lands. We heard some talk a while ago, Senator, about the fires out in Southern California. One thing that struck me and the Secretary as well during those fires in the last few weeks, was that partnerships were not hard to come by. Jurisdictional lines just absolutely disappeared when people were fighting those fires. Everything else aside, the causes and everything else, it was probably the best example of bureaucratic ecosystem management that we could find right now, was the management of those fires, where everybody got together and worked towards one goal.

As I commented earlier, Senator, administrative boundaries often do not correspond to ecosystems boundaries and may complicate ecosystem management. Boundaries for the public lands were primarily delineated to accomplish political and social goals. Ecosystems occur at a variety of scales and Federal agencies are rarely the sole managers of large, self-contained ecological systems. We hope to identify ecologically based boundaries that will assist us in defining long-term resource condition trends and objectives.

BLM is probably the only agency that has 12 State offices and they really had nothing to do with ecosystems. They were political boundaries.

Using a landscape perspective will greatly enhance the ability of resource managers in predicting the effects of management activities on the land, and will give us guidance in working towards greater cooperation with other land management agencies and private land owners. I believe the BLM presently has the authority to do all this without further legislation, although amendments to the existing law could enhance the BLM's management capabilities.

The Federal Land Policy Management Act of 1976 made the BLM a multiple use agency. That is entirely compatible with ecosystem management. Multiple use can support the new American land ethic, to live productively yet more lightly on the land. This is our challenge and we intend to meet it enthusiastically through the use of the new management tools that we are developing to focus on the long term health of sustainable ecosystems.

If I may say, just for a moment, as we approach ecosystem management, it really is going to make us look at our own bureaucratic structure in many ways and how we do this and how we flatten our organizations to get more people out onto the ground, instead of sitting in offices reviewing reports that have probably been reviewed two or three times already. So we really have some hard work to do on our organizational chart, and we are actually well into looking at how we are going to do that.

That is all I have, Senator. Thank you.

Senator DASCHLE. Thank you, very much. I appreciate your statement, Jim.

Let me now call to the table our second panel: Dr. Donald Waller, the Department of Botany from the University of Wisconsin; Dr. Fred Swanson, Forestry Sciences Laboratory, Oregon State University; Dr. Alan Lucier, the program director of the Forest Environmental Studies of the National Council of the Paper Industry for Air and Stream Improvement; and Dr. Chadwick Oliver, Professor of Silviculture, College of Forest Resources, University of Washington.

Gentlemen, we welcome you. We are pleased that you could be here, and our apologies to you for the delay this afternoon. We will take our witnesses in the order that I have called them. Dr. Waller, please proceed.

STATEMENT OF DR. DONALD WALLER, DEPARTMENT OF BOTANY, UNIVERSITY OF WISCONSIN, MADISON, WI

Dr. WALLER. Ecosystem management is a topic vital to the biological health of our national forests, but one that remains only vaguely defined. My involvement in national forest management began eight years ago when several colleagues and I took time off from our academic schedules to evaluate long-term management plans prepared by the Forest Service for Wisconsin's forests. We were dismayed by the marginal treatment biodiversity issues received, and especially by the serious misunderstanding of ecological science these plans, in 1985 and 1986, reflected.

We therefore began a campaign to persuade the Forest Service to apply contemporary principles of conservation——

Senator DASCHLE. Dr. Waller, would you mind pulling the microphone a little bit closer? I see people are straining to hear you. If you could speak up just a little bit, that would be helpful. Thank you.

Dr. WALLER. This was 7 or 8 years ago. We started to try and persuade the Forest Service by any means possible to incorporate contemporary principles of conservation biology, mainstream ideas as we saw them, into managing our national forests. We have had both successes and failures in this effort. I do not want to dwell necessarily on either one, although I would like to note that we have produced, in this past year, a report from the scientific roundtable on biodiversity, 22 scientists working in conjunction with the Nicolet and Chequamegon National Forests in Wisconsin.

But this experience has forced me to become a student of Forest Service behavior. Why is this agency recalcitrant in some ways and not others to efforts to protect biodiversity? Why does it continue to resist reform and break laws, in some instances, even as it cloaks itself in the ecological rhetoric of new perspectives and now ecosystem management? And in particular, what will it need to do to repair its tarnished image in the public's eyes? In pursuing these questions, I have learned that it is more than simple mismanagement and more, likewise, than simple tradition.

I am going to speak first, I think, about a lesson or two that we learned from our own experience, try and analyze the problems as I see them very briefly. I understand the time constraint here. And then I will propose a couple of solutions that I feel Congress should address.

Forest Service leaders have felt entitled, in the past, to flaunt their responsibilities under NEPA and NFMA to fully and honestly divulge the environmental impacts of forestry practices. In passing these laws, Congress intended to hold Federal forest managers accountable for their ecological and environmental effects. NFMA remains the only Federal law with any explicit provision to pro-tect native biodiversity, yet Forest Service leaders continue to in-terpret this diversity provision on a species-by-species basis, retain-ing the worse aspects of the Endangered Species Act, in my opinion, and ignoring the dictates of contemporary conservation biology to take a more ecosystem approach. I agree with Senator Craig in this respect.

We are quite concerned here with what ecosystem management will amount to. I am greatly encouraged by this coming together amongst all the Federal agencies. I am also, however, with regard to the Forest Service anyway, skeptical on the basis of my own experience, including pronouncements made by senior staff within the Forest Service and a history of inconsistent and duplicitous behavior within that agency. We also have a recent record of new perspectives projects failing to live up to their promise.

I wish to touch on a leadership issue because I feel that, although perhaps this is passing, it is one that needs to be addressed. The Forest Service has sought to fulfill two different, and at times conflicting goals, both to conserve and protect national forests and their resources and to provide a stable and sustainable supply of commodities from these forests.

In general, the former has progressively lost out to the latter in response to changing Forest Service priorities. We now encounter a rising crescendo of protest from both the informed public and even its internal ranks. While controversy is not new, current storms of protest extend into the daily papers, prime-time television and the pages of Sports Illustrated.

The problems regarding poor leadership, as I said, may be passing so I do not wish to dwell on them. I do think we need to pay attention to these inconsistent goals, though. I think many people, including many of my friends and colleagues that I respect quite a bit who work for the Forest Service have a very difficult time dealing with what they see as contradictory goals set by Congress for them.

In terms of analyzing these problems, we have an ambivalence in direction stemming from these contradictory internal and external incentives agency personnel face. On the one hand, they are expected to promote conservation and a sustainable harvest of forest resources. At the same time, they face strong pressures to maintain high outputs of commodities at low cost. This comes not only from direct political pressure at times, but from well-intentioned but now outmoded acts, such as the Knutson–Vandenberg Act, which ties internal budgets directly to timber harvests in a way that subverts management of the forest.

Similarly, payments to counties in lieu of taxes dating back to 1908 are tied to logging, ensuring strident local political pressure to maintain high harvest levels. Thus, I see Congress sharing this responsibility for the agency's failure to effectively protect environmental goals. It needs to remove what I see as perverse incentives.

Finally, the atmosphere of uncertainty and intimidation that pervades or has pervaded the Forest Service, I think is a big issue. The Association of Forest Service Employees for Environmental Ethics established in 1989 serves, by its existence and popularity, to indicate that the organization continues, at least in times and places, to give inconsistent signals to its workers and the discord that exists within its ranks.

What can we do about these things? I think we have a lot of opportunities here that should not be overlooked. Assuming the leadership issue has been taken care of or is about to be taken care of, I think we need to also address these contradictory incentives within the Forest Service. We have a lot of budgetary incentives, as I mentioned, but it is the line item appropriations that Congress sets within the Forest Service that I feel contribute directly to environmental damage.

On the last page of my testimony I present a graph from V. Sample's book, regarding the allocation of funds within the Forest Service budgets over the period 1960 to 1985.[1] Aside from changes in political administration, it is quite evident from this graph that line item budgets have greatly favored commodity production over protection of natural values.

Finally, to return to a point that Senator Craig and Chief Unger brought up, I feel it absolutely necessary that planning occur at the appropriate scales. Forest Service planning in the past has tended to emphasize the simultaneous pursuit of competing goals. Such management has had the effect of homogenizing forested landscapes by applying uniform and often intensive management practices to each forest and district. It is far preferable, both from an economic and from an ecological point of view, to sequester divergent and incompatible uses among distinct areas.

Some forests and parts of forests are far better suited to timber production than others. Similarly, certain areas are far more important for sustaining biological diversity or serving other noncommodity uses. It is inefficient and impractical to simultaneously manage for disparate uses on the same land. To protect the regional diversity of species in particular ecological communities and landscapes, it is imperative that the Forest Service planning occur at these broad scales.

Finally, I would like to see a skeptical public convinced of the worth of ecosystem management by suggesting that either the Forest Service or Congress establish a committee of scientists to oversee implementation of ecosystem management within the Forest Service and perhaps over all Federal agencies. Such a committee would simply and cheaply ensure the credibility of these programs while fostering creative solutions to pressing natural resource questions. It would also provide strong incentives to more directly involve the many scientists and specialists within the agency that help make planning and management decisions.

I think I will end it there, to provide time for questions and other presenters.

Senator DASCHLE. Thank you, Dr. Waller.

Dr. SWANSON.

STATEMENT OF DR. FRED SWANSON, FORESTRY SCIENCES LABORATORY, OREGON STATE UNIVERSITY, CORVALLIS, OR

Dr. SWANSON. Thank you, Senator.

I am Frederick J. Swanson, a supervisory research geologist and ecosystem team leader with the U.S. Forest Service's Pacific Northwest Research Station based in Corvallis, Oregon. My present duties include serving as co-leader of the Andrews Experimental Forest and the National Science Foundation sponsored long-term ecological research program there.

I am also a leader of the Cascade Center for Ecosystem Management, which is a partnership involving Forest Service and university researchers and land mangers of the Willamette National

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[1] See page 39.

Forest. The Cascade Center is dedicated to developing new information about the structure and function of ecosystems and about the social values associated with those ecosystems. We are endeavoring to make that information available to the public, to policymakers, land managers, other scientists.

The comments I offer come from the vantage point of working at the interface between research and management in a very public arena. Although this is a particular example from the Northwest, there are others. This example provides some view into how ecosystem management is being formulated and implemented at the grass roots level, which is a critical part of the development of ecosystem management.

At the Cascade Center and at other places, for example, we are exploring ways to manage forest vegetation patterns that follow the patterns of natural disturbances by wildfire and windstorms. Our intent is to meet a broad range of management objectives, including some timber cutting, while maintaining a semblance of the natural habitat with the objective of sustaining native species and long-term productivity within the landscape.

To do so, for example, we have examined the forest fire history for 500 years presettlement, and then have placed our management design within the context of the natural variability of the ecosystem.

We have also been studying stream and riparian systems with several million dollars of Forest Service and National Science Foundation support, then have endeavored to understand how forests affect streams and what the upstream to downstream linkages are within watersheds. We have taken this information and incorporated it into management guidelines. These guidelines are being used on a variety of national forests throughout the United States and are finding their ways into application in other lands.

There is also a great deal of effort dispersed throughout the Northwest in experimentation, testing, demonstration of alternative silvicultural practices in natural stands of many ages and in managed forest plantations. These are a few examples of how ecosystem management is being formulated in the Northwest. It is developing on a variety of fronts. Some of the most aggressive activities and creative activities are occurring where researchers and land managers are cooperating in a very public arena.

I would be pleased to answer any questions at the appropriate time.

Senator DASCHLE. Thank you very much, Dr. Swanson.

Dr. LUCIER.

STATEMENT OF DR. ALAN LUCIER, PROGRAM DIRECTOR, FOREST ENVIRONMENTAL STUDIES, NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., NEW YORK, NY

Mr. LUCIER. Good afternoon. My name is Alan Lucier. I am a forest ecologist and director of forest environmental studies at the National Council of the Paper Industry for Air and Stream Improvement. The National Council is a non-profit membership organization founded in 1943. We provide the forest products industry with research and technical support programs on environmental questions affecting manufacturing and forestry operations.

I appreciate the opportunity to participate in this hearing. Interest in ecosystem management provides an opportunity to define a new vision of forestry on Federal lands. Perhaps this vision can blend environmental and economic objectives, and end the wasteful practice of managing Federal forests by litigation and appeal.

To achieve these objectives, ecosystem management must be more than a philosophical argument for expanding nature reserves. Instead, ecosystem management should be a process for using ecological knowledge more effectively in forest management. To succeed, the process must be tailored to fit the needs and opportunities of diverse agencies and regions. Clear policy guidance from Congress and the administration will also be essential.

A technical basis for ecosystem management can be found in the science and traditions of American forestry. Without question, there are many gaps in our knowledge of forests and important weaknesses in our management systems. But there is also an outstanding record of achievement. In the late 1600's, Sir Isaac Newton was asked how he had been able to make so many important advances in mathematics and physics. In his reply, Newton acknowledged the work of his teachers and peers by saying "If I have seen further, it is by standing upon the shoulders of giants." Today's forest managers and scientists also have giants they can stand on and should not ignore the opportunity.

Fraudulent allegations of wholesale failure in American forestry must be challenged. Accomplishments of American forestry in science, policy, management and education have set standards for the rest of the world. There have also been serious failures and many shortcomings. But on balance, the accomplishments outweigh the failures. The proof is in the productivity of our commercial forests, the vastness and splendor of our nature preserves, and the strength of our forest products industries.

American foresters are proud of their profession and its outstanding record of achievement, but we also know we must do better in the future. It is entirely appropriate, in my view, that we give greater and more consistent attention to ecological principles in our work. Many of our failures and shortcomings have resulted from focusing too intently on a single method or objective, whether it be in timber production, fire suppression, or spotted owl preservation. We must become more willing to question our standard assumptions and our new perspectives.

Investments in research can help translate ecological perspectives into better management. Research can provide objective information about current and possible conditions of forests and related systems. Moreover, research can discover new possibilities for producing, balancing and restoring forest values.

Experience shows that cooperative research involving government, universities, industry and others will be most effective. Priorities for research to support ecosystem management are difficult to define specifically in the absence of coherent policy objectives. As a general strategy, research at the forest and regional levels should evaluate the environmental and economic outcomes of alternative management regimes at a landscape sale.

Environmental outcomes of interest include forest health, water quality, wildlife, plant community diversity and esthetics. Economic outcomes of interest include site productivity, timber supply, recreation, employment and community stability. Research at the national level should focus on technology development, fundamental questions in biology and ecology, assessments of supply and demand for timber and other resources, and coordination of research at the forest and regional levels.

Research has important roles to play in ecosystem management but it cannot determine what mix of values should be produced and sustained in Federal forests. Scientists, like other citizens, may choose to participate in the policy debate. But when we choose to do so, we have a special obligation to distinguish between opinions based on our technical expertise, and opinions based on our personal biases and beliefs. Too often we inflate the significance of our opinions by suggesting they reflect the best available science when, in fact, this best science is mere speculation in support of subjective value judgments.

To conclude, I would like to emphasize two points. First, a scientific basis for ecosystem management can be found in the science and traditions of American forestry. Inadequate consideration and frequent misrepresentation of American forestry have been disturbing features of the debate on ecosystem management thus far.

Second, we should renew and strengthen our commitment to cooperative research in American forestry. This commitment has been tested in recent years by funding constraints, rapid changes in priorities and inadequate separation between scientific and policy objectives. These challenges must be overcome so that the proven advantages of cooperative research can be realized.

Thank you for your attention.

Senator DASCHLE. Thank you very much. I will be asking both Mr. Unger and Mr. Baca for any response they might have to the testimony of the second panel, but before I do, let me call upon Dr. Chadwick Oliver for his testimony.

Dr. OLIVER.

STATEMENT OF DR. CHADWICK OLIVER, PROFESSOR OF SILVICULTURE, COLLEGE OF FOREST RESOURCES, UNIVERSITY OF WASHINGTON, SEATTLE, WA

Dr. OLIVER. Thank you very much. I submitted a written statement to you.

Senator DASCHLE. Yes, and it will be made a part of the record.[2]

Dr. OLIVER. Thank you. I will summarize it. May I refer to some of the tables in that?

Senator DASCHLE. By all means.

Dr. OLIVER. Thank you.

My name is Chad Oliver. I am a professor at the University of Washington. I have been there since 1975. I am a professor of silviculture and forest ecology. I have also studied and taught and done research in most other places in the U.S. and other places in the world.

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[2] See page 50.

I want to talk first about what ecosystem management means to different people, and then a little bit about the other questions that were suggested to me.

One problem we face right now is that we are going through a change in theories in how forests develop. I would like to explain that a little bit. Originally, beginning in the late 1800's and lasting up until probably the last 20 years, we had this concept that forests were relatively stable communities. They grew and sometimes were even thought to be coevolved entities that existed in one structure, often referred to as a "climax," sometimes considered synonymous with "old growth." If we just left nature to itself, it would go to this one condition that was relatively pristine, and would provide all habitats for all creatures.

Over the last 30 years or so, slowly that theory has been changing, so that now the more common theory is the one that is referred to as "constant change." In fact, figure one in my statement refers to this, where we now know that there are these periodic disturbances of various types and various sizes that then cause the forest to respond to these disturbances and begin growing in different ways.

If you look at figure two what you see is that after these disturbances—some of which can cover fairly small areas, some of which can cover hundreds of thousands of acres—you get a variety of different structures: open areas, closed forests, some forests that were partially disturbed, and then some forests that were not disturbed.

If you look in figure two, what you see is that some species grow and grow best in each of these structures. What we know is that these forests grow, we have species migrations, we have climatic fluctuations. So there is no one steady state, nor is there any one forest structure that will be ideal for all creatures.

Historically in our commodity production, in some areas it has been most advantageous for us to clearcut, and then we end up with just eliminating the structure we often call old growth and the species going along with it. Interesting, in other areas, it has been most economically efficient for us to do selection cutting and we have endangered species that live in that open condition in the beginning.

The most current theory is constant change, but there are still scientists, especially those not directly involved in forest ecology, who still follow the steady state theory, as does much of the public.

The result of this is that you get two definitions of ecosystem management. One is to consider old growth an ecosystem and the way to manage it is to just keep it in the old growth condition. The other concept of ecosystem management is to maintain—through manipulations where necessary, protection where necessary—a balance of all of these structures and some fluctuation across each landscape area.

We end up with some interesting considerations here. When we are looking at maintaining biodiversity, one approach (that is more the steady state approach) is that we will take a large area and lock it up as a reserve. And if we have disturbances, they will be small but we will keep some natural balance in those reserved areas. On the other hand, we are looking and realizing that the size of these disturbances and our tendency to have broken up the forests with highways, farms, and cities, means that some of these very large disturbances do not leave all the natural structures.

The alternative approach is to maintain all these structures through this active management. We get into such questions of dealing with uncertainty; I would like to respond to those in the question and answer session.

One thing I want to bring up is a lot of the concepts of ecosystem management also look at other values of the forest. If you look at table one, what I have done is tried to point out that we have several values for the forest: biodiversity; the global environment, which means that if you do not get forest products from one area you either get them from elsewhere or use steel, aluminum, brick, concrete and other things. You have a high cost if you are just going to try to protect the area, in terms of taxes to pay for it, which means that that money cannot be used to protect other ecosystems. And you have unemployment.

The steady state approach, if that theory is correct, creates very low values for these other things in a trade off. If the constant change landscape approach is the approach that is used, then you also produce a much better global environment, lower public cost, and employment as well. But of these two approaches, I favor the landscape management (constant change) approach.

The problem is as long as you have these two theories out legislating ecosystem management is going to be a little bit like trying to legislate a scientific idea. Or if you just say do ecosystem management, you may have it tied up in courts, so that different scientists argue differently over what ecosystem management means.

As a suggestion it may be more appropriate, instead of legislating ecosystem management, to legislate that all habitats and species populations be maintained across a landscape area, with some type of a threshold underneath so that, if a species becomes endangered, you do extra work to maintain that one, but not at the risk of other species. What that will do is keep a balance on the landscape. This balance can be maintained through active silvicultural operations.

If there is sufficient old growth in an area then fine, you would leave it. If there is insufficient old growth, you would do the manipulations to create as much of the structure as possible. At the same time, there are other places where there is a lack of open areas, where you would do some various harvesting methods to create those openings.

What you would be doing at the same time would be producing wood products and other such values, employment being one. So we are looking at a joint production of different values.

The interesting thing is in places for the production of wood alone it may not be economically feasible to do that various harvesting. So it would be what we now call a below cost timber sale, but the objective is not to strike the timber. That is a byproduct of maintaining a balance of structures across the landscape.

Now this joint production would reduce the cost of ecosystem management dramatically. Another thing I would emphasize is that if we have learned anything from the collapse of the Soviet Union, it is that central planning is very inefficient. If we can find a way that we can have each local manager begin moving towards some balance on each landscape area, then we can build up a coordination from a bottom-up approach.

I teach midcareer foresters in the Forest Service this landscape approach in our silvicultural certification programs, and it is a program that they can very readily and very excellently adapt. Another advantage of having them adapt it is that they give us feedback in how to implement it a lot more efficiently than if it were imposed from the top.

Just a couple of other comments. There are a lot of conflicting laws on State and private lands. Incentives will be better than regulations. But it may almost take a targeting of the forest environment, including wood products which is an environmentally strong segment of the economy, and then looking at which laws are really in conflict with each other because there are some counterproductive ones.

The last thing I wanted to do is talk a little about research needs. We have done a lot of ecosystems research in the last 25 years. I would encourage a lot of research not just looking at the old growth but looking at the values of all the different structures. And then I would encourage a lot of research at the implementation of landscape management—the use of landscape scale GIS systems, the use of various silvicultural tools that can create these structures where they are presently in short supply.

In addition, the more research we can put into making wood products highly valuable will make it much more efficient to do the landscape management and we can use these wood products as alternatives to more polluting substances. It would be a very environmentally promising thing.

Thank you very much.

Senator DASCHLE. Thank you very much, Dr. Oliver.

Mr. UNGER OR MR. Baca, do you have any response to what you have just heard?

Mr. UNGER. I might just say that this idea that the Congress may have given us an agenda that is so inconsistent that we cannot follow it deserves some discussion. Obviously, there is a tremendous challenge when we look at the Organic Act, the Multiple Use Sustained Yield Act, the National Forest Management Act, NEPA, and the Endangered Species Act. There are certainly places perhaps where we could identify ways for things to mesh a little bit better.

But I think there is also a great deal of flexibility that we have and this flexibility allows us to practice ecosystem management to a large extent. We have been doing it in many places and are doing it in more.

I am reminded, and it seems to me the key to this is sustainability and doing these things in a sustainable manner. I am reminded when the chairman of this full committee, Senator Leahy, spoke to our leadership in the Forest Service two or three years ago and encouraged us to look for systems that would enable us to provide all the values, all the services, all the products, all of the uses of the national forest in a sustainable way.

We think that ecosystem management provides the approach for doing that, and we think that we can do a great deal under the framework of the laws that exist.

Senator DASCHLE. Mr. Baca?

Mr. BACA. Senator, I was taken with Dr. Oliver's comment on the ability of local managers to manage. I can look out in the west, in some of the arid lands, and just about everywhere else and know that, in fact, they cannot manage, even if they were under a guise of ecosystem management. Just when I look at the 1872 mining law which does not give them the ability to say this is the right place for mining, this is not the right place for mining. They are just going to mine, whether they want to or not.

So there are some conflicting things that we really have to work out here if we are going to make it work. Certainly the local governments, State governments, county governments, everybody is going to have to be brought into the loop. Just on the grazing reform matter here, we have seen half the western Governors like what was being done, half did not like what was being done. Half the land commissioners thought it was great, half did not think it was so great.

We have to get all these different levels of government into some sort of mode where they can accept ecosystem management because given the checkerboard pattern of our land ownership out west, they have to be on board.

Senator DASCHLE. First of all, let me indicate that Senator Craig was called to the floor and he has a number of questions that he would like to submit for the record for you to respond to.

My first question deals with the point raised in the 1992 system management policy that the Forest Service set forth which called for more public involvement. Public involvement over the last few years has primarily been the appeals process, much to the chagrin of many and to the frustration of just about everyone. The appeals process, in my view, was a very cumbersome vehicle for public involvement. I now note, as of last week, the Forest Service has published their final rule. We now have a new appeals process for which people can appeal decisions by the Forest Service.

I think I am encouraged by that. I have not had much of a chance yet to review the process to the degree I want to, but I would be interested in our witnesses commenting on that decision.

But more broadly, Mr. Unger, I would be interested in what plans the Forest Service has for public involvement. If indeed, as the management policy calls for, we are going to attempt broader public participation and involvement by multi-faceted interests, to what extent are we going to encourage that and what vehicles will be used?

Mr. UNGER. As one of the people in the Forest Service who has been responsible for making many appeal decisions and reviewing many appeals, I certainly am sympathetic with the idea that an extensive group of appeals is not necessarily the best way to get on with the management of these resources. But we have, as you say, in response to the appropriations act, published the final rule setting up a revised appeals process which incorporates a largely expanded public participation process.

I would like to say that I do think we have, in the Forest Service a rather remarkable record of extending the opportunity to people to comment on what we are doing by having an appeals process which has not, up until this time, been legislated but which has been voluntarily, to give those who are dissatisfied with our decisions an opportunity to raise them to a higher level and have them decided in that way.

We have also had extensive participation in our environmental impact statement process and in other ways trying to get people trying to take an interest in these matters.

Under our new rule we have extended this through this law to projects and environmental assessments as well as environmental impact statements and we are now in the process of developing a training program for our people to find ways to best present these proposed decisions to them and secure their comments and incorporate them in our decisions. I think that this is a very good and important vehicle.

I think that we probably ought to be looking at some other more innovative ways to add to our knowledge of how the public feels about what we are proposing to do. I do not think that government as a whole, for example, has used modern opinion sampling methods, polling, focus groups, or other ways of securing in a more scientific way the information on the attitudes and opinions and desires of the public. I think we need to explore those ways and use them in our decision process.

Senator DASCHLE. I have two follow up questions. How, in your view, has the decision of last week been received by those affected?

Mr. UNGER. From what I have learned so far, I believe that most of the people who have seen the final rule feel that it is a much improved version over our draft rule, which was earlier distributed.

Senator DASCHLE. Any disagreement among our panel in that regard?

Dr. WALLER. I was involved in extensive criticism of the original rule proposed. This was, I think the ANPR of 1991. Is that what you are referring to?

Mr. UNGER. Jim, was that done—that was not done under advance notice rule?

Dr. OVERBAY. I think he is referring to the planning rule, not the appeal rule.

Mr. UNGER. This was the appeal rule in response to the Interior Appropriations Act, which provides for appeal of specific decision projects, individual projects.

Senator DASCHLE. The other question would have to do with the degree to which the Forest Service is prepared to be more consultative with all affected entities. I think that, in part, there has been some legitimate criticism. I think the Forest Service can certainly point to those occasions when there was consultation, but the impression I have is that it really was not standard practice.

I am wondering to what extent, as a result of your ecosystem management plans, you intend to become orchestrated in the consultative process?

Mr. UNGER. We do intend to be and certainly in those cases where this has not happened in the past it has not been by design. We favor this kind of consultative process. We believe that an essential part of ecosystem management is strengthening that process and strengthening the use of partnerships.

I would like to provide, if I may, for the record, following this hearing some examples, these five examples that I listed in my testimony of ongoing projects where we have followed ecosystem management principles. In every one of those there has been a well worked out process of working with partners, local, State and Federal governments, private citizens, Indian tribes, a variety of people in working out the details and securing support for the project.

I think that would show the kind of thing that we like and that we want to advance with this new approach.

Senator DASCHLE. Dr. Oliver mentioned research and others alluded to it. Obviously we have learned a lot about the effects of forestry practices over the years, and I am wondering to what extent we are going to allow these practices to be considered, and to what extent there will be greater input from ecologists, scientists, users of all kinds in determining our longer term planning? I would be interested in Dr. Swanson's answer to that question.

Where would you see people like you and colleagues of yours entering into the consideration of new information and discussion of implementation of policies affecting practices?

Dr. SWANSON. The level of interaction between managers and researchers and scientists has intensified greatly over the past few years. I think it was really accelerated as a result of many lawsuits, particularly in the Northwest and North Central area. I now believe it is moving into a phase that is not so reactive, but more proactive, along the lines of some of the examples that I tried to give earlier.

I am very encouraged by the prospects for much greater interaction between scientists, managers, and the public in formulating future management designs.

Senator DASCHLE. Are you satisfied with the level of interaction you feel there is today?

Dr. SWANSON. Yes and no. I think there is a very serious effort to increase the level of interaction on the parts of the managers, in particular. I think it is necessary, in part because of the legal situations we found ourselves in. "We," in a societal sense.

So I think it is growing. We have a lot of work to do. We are asking ourselves new questions as a result of management and policy decisions. Much more science is necessary to answer these questions. Scientific analysis of new questions will push us into some new dimensions.

Senator DASCHLE. One example is salvage logging. There has been a considerable amount of literature that would indicate there are beneficial ecological effects of leaving behind dead trees and biomass and I understand that leaving dead trees in the forest provides a lot better wildlife habitat, reduces erosion and it harbors important fungi and bacteria and provides stream habitat for fish. But in the past this material has been cleared and burned.

I have three parts to this question and I would be interested if any of the panelists might address this. First, should we leave more of this material behind in the forests? Secondly, is there a fire danger associated with this practice; and if so, how could you minimize the danger? And third, can and will ecosystem management practices address issues like this, or is that too specific? Dr. Oliver?

Dr. OLIVER. I would like to mention that what we have to realize is that there are species that utilize this dead wood on the ground, in the streams or standing snags. There are other animals that we—well, certain animals we know are adversely affected by it.

We also know that if it is put everywhere, then you end up with a very big fire hazard. Just as I mentioned earlier, there is no one structure or condition that is all things to all animals. What we need is some kind of a mosaic of different structures across the landscape.

In fact, if you look at the way natural disturbances occurred, there were places where winds blew large areas over, the trees dried out and you had such a hot fire that you did not have much; then they reburned and you did not have much organic matter left. Other places had down materials.

What I would see is ecosystem management addressing this by having a mosaic, some places where there are down materials, some places where there are not. And the fact that you do not have a continuous large area would help keep from having a fire start in one place and spread very far. Also, the lack of continuity would mean that in the places where you had down materials and you had insects breaking out, you would not have that spreading too far. So like everything else, it is something done in some places but not everywhere.

Does that answer your question?

Senator DASCHLE. Yes, it does. Anybody else wish to respond to that?

Dr. WALLER. I think we have a tendency to think about the Northwest. I would just like to mention that coarse woody debris has many important ecological functions that we now know about, and yet coarse woody debris does not exist in many eastern forests because coarse wood does not exist. The trees simply have not had time to go to the size of the trees that were there once and still exist in the Northwest.

By all means, I would consider this a central issue for ecosystem management to address.

Senator DASCHLE. My colleague, Senator Cochran, is here. I am delighted he is and I would call on him for any statement or comments he wishes to make.

Senator COCHRAN. Mr. Chairman, I appreciate your recognition. I have a statement that I would like to have put in the record of the hearing.

Senator DASCHLE. Without objection.

Senator COCHRAN. I came here to see what I could learn about the ecosystem management issue and whether or not, as a member of the Appropriations Committee, we can expect to have a request for a line item appropriation for ecosystem management. I know there was a discussion of that, at least at the staff level. I do not recall any discussion in hearings on that subject.

And just what the reaction of the acting chief is or the others, about the level of funding that we are going to see being requested for this activity.

Mr. UNGER. As we have yet to learn more about the practice of ecosystem management, we will learn more about how to budget, how to account for, how to measure the results of ecosystem management. We have discussed the idea of incorporating into one line item many of our inventory and planning activities which will be the basis for and support for ecosystem management into one group of items.

On the other hand, as we progress with this effort as organizationally—as Jim Baca pointed out—we need to change our organizations to reflect ecosystem management across the board in all of our activities and all of our staffs of all of our functions, whether it be timber, wildlife, watershed protection or whatever. That poses a challenge as to how to describe the outputs, the benefits and the dollars needed to support changing our organization.

So we are looking at both approaches, separating at least some of the functions and also the idea that we need to be practicing ecosystem management across the whole organization.

Mr. BACA. Senator, we are doing some extensive work on our budget and starting to put together a shadow budget so we might see how it works before we come to talk to you all about it.

I am not so sure that you are going to have a line item there that says ecosystem management. I think you are going to have a lot of different things in there that may not require different monies, it is just going to be structured differently and the way we organize out in the field and where the money gets to.

Senator COCHRAN. I know that in the conference report we just adopted on a record vote earlier this afternoon there are provisions in the Interior Appropriations Bill calling for ecosystem management research partnerships with universities and private industries. I wonder if there has been any planning going on about exactly what kind of research would be done by universities and particularly private industry that might be helpful to the forest system?

Mr. UNGER. I would like to ask Dr. Swanson to respond to that.

Dr. SWANSON. In the areas of silviculture and harvesting systems, for example, I believe university and industry researchers could contribute quite a bit. Also, in our experience, there are many industry scientists, both ecologists and fishery scientists, who are cooperating with the Federal scientists in the development of studies that are relevant to ecosystem management.

Senator COCHRAN. Thank you very much, Mr. Chairman.

Senator DASCHLE. Thank you, Senator Cochran.

[The prepared statement of Senator Cochran follows:]

STATEMENT OF SENATOR COCHRAN

Mr. Chairman, I join you in welcoming our witnesses today and thank you for holding this hearing on the Forest Service's plans to define and implement ecosystem management in its management of our U.S. Forest Service lands. As we address changes in our endangered species protection laws and other legislation, we must be mindful of the efforts already underway by the Forest Service and other agencies to address questions of sustained development.

I applaud your work to achieve this common goal and hope that we can find a balanced, commonsense approach to the management of our Nation's valuable natural resources which protects these fragile species while ensuring that our Nation, the strongest economic power in the world, can continue to maintain a strong level of sustained development.

Senator DASCHLE. We have been talking about research. Obviously, there is a certain degree of ongoing research that can be incorporated into forest management plans as it becomes available. But I am wondering, as I look at your designs for ecosystem management, how that works.

As this research becomes available, how do you intend to revise your forest plans to account for that research?

Mr. UNGER. Let me start that discussion, and I want to endorse what Dr. Swanson said earlier about the growing interaction between researchers and managers in the Forest Service, not only for the practical reasons of having the most defensible projects from a legal standpoint, but because we believe that this is the way as professionals that we need to manage, is on the basis of the best scientific information.

I have had the professional pleasure, in the last 18 months, of working on the project in the Forest Service and with the Bureau of Land Management on the strategy for Pacific salmon and steelhead habitat resources on national forests and BLM lands.

From the beginning we established that as a joint management research operation. On our policy committee a person who is my opposite number in our research organization was coleader with me, along with one of Mr. Baca's chief deputies. On our field team we had coequal leadership between management and research. On our working groups, we had coequal leadership from both research and management.

We relied heavily on our researchers to take the body of knowledge that existed about the salmon resource provided to us, help us in designing proposed standards and guidelines, proposed techniques such as watershed analysis and the selection of key watersheds and other principles of operation that are enabling us to put together a package that will provide the basis for the development, hopefully at some future time, of an environmental impact statement that would have the result of amending the forest plans with the scientific information.

So I think that we have some good working examples like that that we can build on.

Senator DASCHLE. A good example would be the Option 9 in the Pacific Northwest for FEMAT. Do you intend to amend the existing plan to incorporate Option 9 developed by the FEMAT scientists?

Mr. UNGER. The decision that is under consideration in the environmental impact statement would amend the forest plans in the northern spotted owl forests. That would be the end result of the process, would be putting in effect those changes.

Senator DASCHLE. The impression I get is there is a wealth of research for some forests and a dearth of research on other forests. The Black Hills may be a pretty good example of that. There is not much research base there.

To what extent will the Forest Service, as they begin putting these management plans together, begin to address that maldistribution of research if you will?

Mr. UNGER. Fred may want to respond to that and, as a matter of fact, I would like, if I may have your permission Senator, to ask Jim Overbay, our Deputy Chief for the National Forest System, who was once a supervisor in the Black Hills National Forest, to respond to that as well?

Senator DASCHLE. Jim, welcome. Have you got a good answer?

Mr. OVERBAY. Senator, when I was in the forest, which was in the mid-seventies, we had a very close working relationship with the research project at Rapid City. They had a number of researchers there that were working on silviculture and watershed and wildlife habitat. There was an experimental forest right in the middle of the Black Hills. A lot of that was applied there. We took that research and immediately applied it on the forest.

The direction changed after I left there, and I cannot tell you why, but the focus of that particular project was changed to look more at the woody draws and some of the range relationships out east of the forest and not on the forest itself. So in the last 15 years or so, there has not been a lot of research there.

Senator DASCHLE. Has or has not?

Mr. OVERBAY. Has not. As far as silviculture and practices on the forest, I look back to that relationship that I had with the project leader in Rapid City as one of the better examples of research and management working together and hopefully we could get back to those kind of relationships.

We have recently set up a very similar kind of an organization down on the Ouachita National Forest where the researchers are working directly with the managers. We need to do more of that.

Senator DASCHLE. I cite the Black Hills as an example, not necessarily as a criticism, but I sense from the discussions I have had and really from my cursory review of what research is available nationally that there is a preponderance of research in some forests and, as I say, a real lack of consistency as we apply research data to the other forests.

I would hope that as we consider ecosystem management that we are talking nationally here, that we are not really developing an ecosystem management plan which incorporates the best utilization of research in one forest and completely ignoring the need for research in another.

I obviously understand the importance of one forest over another for various reasons, timber sales, ecological questions, a whole range of things. But it seems to me there is a tremendous disparity in the applicability of research principles and policy from one forest to another.

Would any of the panel members care to address that? Tell me if you disagree, just do it tactfully.

Mr. BACA. I do not disagree. I would just like to say that over at Interior, we have started up the National Biological Survey. I think this is an attempt at trying to even out, I think maybe who gets what attention. We have Fish and Wildlife, we have BLM, we have all the other agencies involved over there, each doing their own research in their own corner of the world. So this concept of the National Biological Survey, I think, was meant to get Interior and probably sooner or later the other agencies on board in some sort of systematic research.

Dr. SWANSON. I would just like to add that I think we need a mix. We want to have a certain level of scientific support across the board, but we also need to still make a place for those particular places where in large part, through key linkages with the universities, you can have large and intensive research efforts.

Many of those intensive efforts are fueled with funding for basic research where the lessons hopefully will be broadly transferred. Then you can use the talent in that uniform, minimum base of scientific effort to transfer those lessons from the intensive sites and make it more locally applicable. So I think we need to make sure we have room for both approaches.

Dr. WALLER. I would like to point out that the NBS initiative that Interior has pursued is in stark contrast to what has happened, so far anyway, in the Forest Service. I think that is a clear indication that Interior is getting out in front of the curve and attempting to assess in a more comprehensive and, as was said, proactive way.

It is not clear to me yet that the Forest Service has substantially moved beyond the reactive posture of simply throwing research at issues that have clobbered them in the courts or in appeals.

Senator DASCHLE. As I understand it—Dr. Oliver, did you have a comment?

Mr. OLIVER. If you do not mind, I just wanted to make the comment that when I originally said in all areas, I was not just talking geographically.

Senator DASCHLE. I understood that and I appreciate that. I was talking geographic, but I understand your comments related to a broader array of research needs.

Mr. OLIVER. Not only needs, but also looking at all structures. Thank you very much.

Mr. UNGER. I would just like to mention that the adoption of ecosystem management as a principle in our organization has led us to begin looking at our entire research program to look at the priorities that we are placing on different kinds of research. I think that the demands of this are going to be changing some of these priorities as we move into this new age.

Senator DASCHLE. It is not only research, it is also the issue of standards and guidelines. As I understand it, standards and guidelines are a matter of course in timber contracts.

To what extent will standards and guidelines be incorporated into ecosystem management processes?

Mr. UNGER. They will be incorporated to a great extent. Of course, the standards and guidelines apply not only to the process of timber sales, but to recreation projects, to the grazing program and range management and all the other aspects of forest and grasslands management.

The process of redoing the forest plans, which is already underway, the next generation of forest plans will be incorporating the latest information and the development of new standards and guidelines where they are necessary, where we have information that indicates that they need to be revised or new ones added. That is at the heart of the forest planning process and that is underway. By next year we will have 60 forests developing their next forest plan.

Senator DASCHLE. Have you concluded whether or not revisions of standards and guidelines will be necessary to incorporate them into the ecosystem management strategy?

Mr. UNGER. They are going to have to be developed, as I believe somebody else said earlier, on a local basis, taking into account the circumstances of the forest and the plans and objectives developed in consultation with our publics.

Senator DASCHLE. The other Federal agencies, EPA and Fish and Wildlife, have jurisdiction over some of these issues. Clean water, endangered species and soil conservation are all important issues that presumably are going to be addressed through the ecosystem management.

You have mentioned PACFISH, the PACFISH program, and it obviously represents an important vehicle for cooperation for BLM and the Forest Service, but could you describe how PACFISH got started and what has been accomplished by it and whether you see this as a model for cooperation, not only between Forest Service and BLM but Forest Service and EPA and Fish and Wildlife?

Mr. UNGER. It began as an initiative in response to a report by the American Fisheries Society, which was sort of a wakeup call on the status of the salmon stocks that were in jeopardy in Oregon, Washington, Idaho, Alaska, and California.

We began it as a Forest Service project to see if we could deal with the problem of habitat on our own lands, although we briefed other agencies widely on what was underway and invited their cooperation. Partway through the project it was evident to both the Bureau of Land Management and ourselves that a much closer working relationship was necessary. We shared many of the same problems, and came to a joint conclusion.

I would say if we were starting PACFISH today we would, based on what we have learned and the climate of cooperation that has developed, that we would try very hard to also incorporate in this planning effort the National Marine Fisheries Service and the Fish and Wildlife Service and the Environmental Protection Agency, although we have kept them all informed and they have all endorsed what we have been doing, I think we could have an even better product if we were to do that again.

The FEMAT exercise in the Pacific Northwest I think, as controversial as it has been, has been an outstanding effort to try to involve a wide variety of agencies in working together and I think we need to build on that kind of working partnership in the future.

Senator DASCHLE. We are out of time unfortunately, and I do have a number of additional questions. I know Senator Craig has a series of questions, but we will submit them for the record and ask that you respond to them for the record. We will keep the record open for five additional days.

With that, let me thank all of our witnesses for your participation this afternoon, and the hearing stands adjourned.

[Whereupon, at 4:28 p.m., the hearing was adjourned.]

APPENDIX

DAVID G. UNGER

Mr. Chairman and members of the subcommittee: Thank you for the opportunity to offer our views on ecosystem management strategies on National Forest System lands. I am accompanied by Dr. Fredrick Swanson, Supervisory Research Geologist and Ecosystem Team Leader from the Pacific Northwest Forest and Range Experiment Station in Corvallis, Oregon.

BACKGROUND

In June 1992, the Forest Service announced ecosystem management as the framework for managing the national forests and grasslands. This announcement followed a two-year experiment in ecological approaches to management that we called "new perspectives." Although ecosystem management is a new land management philosophy, the Forest Service is well positioned to develop ecological approaches building upon nearly 100 years of land management experience and a broad array of expertise including Forest Service research scientists and field-level resource professionals. This effort is supported by the direction provided by the Organic Act, the Multiple Use-Sustained Yield Act, the National Forest Management Act, and the forestry provisions of the 1990 farm bill.

ECOSYSTEM MANAGEMENT

Ecosystem management is a holistic approach to natural resource management, moving beyond a compartmentalized approach focusing on the individual parts of the forest. It's an approach that steps back from the forest stand and focuses on the forest landscape and its position in the larger environment in order to integrate the human, biological, and physical dimensions of natural resource management. To carry out ecosystem management, the attention of land managers must be directed to understanding the structure, function, and variability of ecosystems and developing appropriate site-specific management activities. Because of its complexity, ecosystem management requires an accelerated scientific effort and the efficient incorporation of science into on-the-ground projects. It also depends on grassroots participation in decisionmaking and partnerships to achieve shared goals.

Ecosystem management means considering the whole fabric of our natural resources as we make decisions; understanding and preserving the vital connections between land, water, wildlife, vegetation, and human beings; and assuring that we provide the values, uses, products, and services desired by the public in a sustainable manner. Comprehensiveness, connections, change, and sustainability are the watchwords of ecosystem management.

I would now like to take a few minutes to discuss how we are implementing ecosystem management.

SCIENTIFIC FOUNDATION

The scientific basis for ecosystem management is provided by Forest Service research and cooperating scientists from other institutions. Forest Service research is focusing its resources on developing and providing scientific and technical knowledge to improve the productivity, health, and diversity of forests and grasslands. An enhanced scientific underpinning is fundamental to taking an ecosystem approach to managing our natural resources on a sustainable basis.

Our Forest Service Research strategy concentrates on:

- Understanding ecosystems where the focus is on understanding the makeup and function of forest and grassland ecosystems. This research will provide the basis for addressing the health and productivity of natural and managed systems, and help us understand how these ecosystems are affected by natural and human disturbances. Two key components of this effort will be to examine ecological trends, including major disturbance factors to estimate past and future conditions, and to monitor results of management activities to ensure predicted conditions are achieved.
- Understanding people and natural resource relationships where emphasis is being given to learning more about how people perceive and value the protection, management, and use of our natural resources. This component reflects our recognition that people's needs, uses, and attitudes affect all forest and range resources. Our research will focus on understanding the interaction between humans and ecosystems—including peoples' needs and demands for resources, and how people value and perceive these ecosystems.
- Understanding and expanding resource options, with the goal of determining and developing stewardship practices and utilization systems that protect and enhance long-term resource productivity and biological diversity. Special attention will be given to interactions among resources in response to a variety of activities aimed at achieving management goals. We will apply this research to improve our on the ground management.

COOPERATION

Ecosystem management includes a commitment to working with even more partners than we've had in the past.

Because ecosystems cross boundaries, many Federal, State, and county agencies; Tribal governments, private landowners; community leaders; and corporate foresters are interested in ecosystem management. We recognize the sensitivity of private property rights and the questions about how ecosystem management can be implemented across property boundaries. Cooperation is the key to success.

In our State and private forestry work, our objective is to provide technical and financial assistance to Federal and State land managers and to nonindustrial private landowners. Through this effort, we can help land managers and landowners meet their objectives for their land by encouraging the use of sound ecological approaches. In addition, the Forest Service helps rural communities develop local natural resource-based economies that support sustainable ecosystems. All programs are voluntary and carried out in accordance with Federal, State, and local laws; actual decisions on resource management are left to the landowner.

IMPLEMENTATION

Now I would like to take a few minutes to describe some of the changes that are underway to implement ecosystem management in Forest Service activities.

First, we have adopted an ecological unit framework to provide a scientific basis for ecosystem management. The framework is a classification and mapping system for stratifying areas into ecological units that have common biological and environmental factors. These factors include climate, physiography, water, soils, air, and natural communities. We have been working closely with other Federal agencies as we developed this framework.

Second, we have completed some major regional ecosystem assessments, are beginning some others, and are setting out parameters for others. An example was our full participation in the interagency Forest Ecosystem Management Assessment Team (FEMAT) report for the Pacific Northwest and northern California spotted owl forests. We prepared the Eastside Forest Ecosystem Health Assessment for eastern Oregon and Washington. Also being completed by the Forest Service and Bureau of Land Management is a strategy for protecting the habitat of Pacific salmon and steelhead (PACFISH) for Oregon, Washington, California, Alaska, and Idaho. Another just beginning is for the Sierra Nevada in California.

These and other assessments provide the basic information to be used in our land management planning process.

Third, we are following ecosystem management in many on-the-ground projects. These include the White River Ecosystem Initiative in Vermont, the Hurricane Hugo Restoration in South Carolina, the Cicero Fire Recovery/French Creek Fisheries Project in South Dakota, the Blackbark Beetle Thinning in Oregon, and the Butte Valley National Grassland project in California.

COLLABORATIVE EFFORTS

A wide variety of partnerships, involving managers, universities, other agencies, and the public at large are important elements of these efforts. We have strengthened our working relationships within the Department of Agriculture, especially with the Soil Conservation Service, and with the Environmental Protection Agency and agencies of the Department of the Interior and the Department of Commerce. We are actively exchanging ideas on how to better coordinate policies among agencies and how to standardize information across administrative boundaries.

future needs

While we have taken some significant steps toward an ecosystem management approach for the Forest Service, there is still much work ahead.

We are looking at several areas where we may need to change our current policies to implement fully ecosystem management. There may be areas where changes in our existing statutory framework would be desirable. We do know that we will need to change our regulations to streamline our land management planning process and to base it upon ecosystem management principles. We expect to propose these regulatory changes in early 1994.

We are still experimenting with operational applications of ecosystem management, and these first projects continue to demonstrate needs for additional information and analysis, as well as point out ways to do a more effective and efficient job.

We do not see a "final" system for ecosystem management in the future. This is an evolutionary process, and new information will constantly result in changes. We believe that a key element of ecosystem management is a consistent monitoring effort, an evaluation of management outcomes and, where necessary, adapting our management to incorporate new information from the monitoring, the scientific community, and the public.

SUMMARY

Although built upon a long history of natural resource management, ecosystem management is still in its infancy. That is why we are purposely moving cautiously and adapting our on-the-ground management as we learn.

The ultimate success of ecosystem management—management that recognizes that people are an integral part of the ecosystem and their needs must be blended with environmental concerns—depends on how we focus our scientific inquiry and apply science to management. To accomplish this, we are taking a new look at our information needs, focusing our scientific analysis to address these needs, and aggressively putting our science into practice. We are taking a holistic, landscape-oriented perspective in conducting research; making greater use of interdisciplinary approaches in our research and planning; expanding partnerships to define, conduct, and use our scientific results; developing new methods for monitoring ecosystem health and productivity; and adapting our management to incorporate new information.

Mr. Chairman, this completes my prepared statement. We will be pleased to respond to any questions you may have.

JIM BACA

I am pleased to be here today to discuss the approach of the Bureau of Land Management (BLM) for ecosystem management.

Secretary of the Interior Bruce Babbitt has made ecosystem management a pivotal principle for land and resource management by the Department of the Interior (DOI). It is our new American land ethic. The BLM has enthusiastically adopted this principle and is working diligently to develop an approach to ecosystem management on the 270 million acres of public lands and vast subsurface mineral resources for which it has stewardship responsibilities.

The BLM's approach to ecosystem management will be consistent with the Vice President's many initiatives to reinvent government and will be melded with the emerging consensus of the President's Council on Sustainable Development.

The word "ecosystem" clearly implies some form of a geographic delineation, one that crosses the traditional geopolitical boundaries by which we have managed our lands and resources.

The backbone of our management approach will be the setting of common goals and developing consensus among diverse interests. These goals must be developed within the limits imposed by sustainability of natural systems if we are to ensure long-term viability of our resources and the economy.

The BLM views ecosystem management as the integration of ecological, economic, and social principles to manage lands and resources in a manner that safeguards long-term ecological sustainability. The primary goal of ecosystem management for the BLM is to develop management strategies that will maintain and restore the ecological integrity, productivity and biological diversity of public lands. Among other things, sustainable ecosystems provide high quality habitat for fish and wildlife; clean drinking water for communities; and economic and recreational opportunities. Our goal will be to implement management strategies to protect the integrity and diversity of ecosystems and to ensure economic, recreational, aesthetic, social, and cultural benefits from the land for present and future generations.

In the past the BLM's resource management placed emphasis on commodity production and the sale of natural resources. Management objectives were generally designed to expedite the development, extraction, and/or production of resources on public lands. Other uses and values such as wildlife and fish habitats, some recreational activities, cultural, scenic, and aesthetic resources were often viewed as adjuncts to more intensive uses.

The lack of the broad view encompassed by an ecosystem approach may have led to increased sedimentation in streams; less productive rangeland conditions; fragmented plant, animal, and fish habitats; and forest health problems. Population growth, increased use, and other factors, have also contributed to degradation of the public lands and caused significant declines in the distribution and populations of many native flora and fauna.

Many communities whose economies depend on public lands are affected because an ecosystem approach was not used. The declining timber and fishing industries of the Pacific Northwest, for example, demonstrate the economic repercussions and social displacement that can accompany ecosystem degradation. Conservation efforts on public lands make a critical difference to the viability of vulnerable plant and animal species and the stability of local economies. Unfortunately, poor forest and rangeland health, degraded riparian areas, and inferior aquatic habitats often threaten species' viability, resource productivity, and ultimately, the overall sustainability of ecological systems.

Because of such conditions and impacts to the public lands, we must take a holistic approach. Under ecosystem management, the BLM will manage the public lands to sustain viable ecological processes and functions. We intend to conserve, maintain, restore, and enhance the ecological integrity of the land and its resources while providing for human values, products, and services and assuring ecological sustainability.

The BLM hopes to develop partnerships to identify and achieve healthy, fully functioning conditions on our public lands. We plan to coordinate management practices with public, local, State, Federal, tribal and interested private land managers, universities, and other involved parties, exchanging data to resolve resource issues that may also be faced by other land management agencies. In this regard, the proposed National Biological Survey will be a tremendous and valuable resource.

The BLM is already involved in a number of projects that embody some ecosystem management principles. I will highlight two of them:

- In March 1993, the BLM and the Forest Service joined in development of a strategy to restore anadromous salmonid habitats on public lands. The program, known as PACFISH, committed the agencies to developing a common strategy that would conserve and restore Pacific salmon and steelhead habitats and associated watersheds in the West including Alaska. PACFISH stresses the integration of sound scientific and research information with on-the-ground management direction.

- In Idaho, the BLM has initiated an Ecosystem-based Management Budgeting System to simplify and streamline budget development, harmonizing the process to support field ecosystem-based management. This process emphasizes major programs and initiatives rather than traditional subactivities.

Attached to this statement are other examples of projects involving ecosystem principles in which the BLM is involved. As Director, I hope to encourage on-the-ground initiatives and innovations such as these projects, which can serve as models for the future.

As I commented earlier, administrative boundaries often do not correspond to ecosystem boundaries and may complicate ecosystem management. Boundaries for the public lands were primarily delineated to accomplish social and political goals. Ecosystems occur at a variety of scales and Federal agencies are rarely the sole managers of large, self-contained ecological systems. We hope to identify ecologically based boundaries that will assist us in defining long-term resource condition trends and objectives. Using a landscape perspective will greatly enhance the ability of resource managers in predicting the effects of management activities on the land, and give us guidance in working toward greater cooperation with other land management agencies and private owners. Specifically, we will seek to:

- Identify management units that will facilitate management, including analyses of cumulative effects;
- Identify and manage the habitats of threatened and endangered species and rare flora and fauna on public lands;
- Identify sustainable commodity production levels within an ecologically based boundary (e.g., timber harvest in a watershed, forage production across a landscape); manage these resources accordingly; and
- Implement threatened and endangered species recovery programs.

I believe the BLM presently has the authority to do all this without further legislation, although amendments to existing law could enhance the BLM's management capabilities. The Federal Land Policy and Management Act of 1976 made the BLM a multiple use agency. The law defines multiple use as:

> * * * [H]armonious and coordinated management of the various resources without permanent impairment of the productivity of land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.

Multiple use is compatible with ecosystem management. Multiple use can support the new American land ethic—to live productively yet more lightly on the land. This is our challenge. We intend to meet it enthusiastically through the use of the new management tools that we are developing to focus on the long term health of sustainable ecosystems.

The following are additional examples of BLM projects involving ecosystem principles.

- In California, the BLM entered into a Memorandum of Understanding with Federal, State, and county agencies to develop a coordinated, statewide biodiversity planning strategy. The effort coordinates the actions of the principal land management agencies under the long-term goal of maintaining economic growth and development while conserving the rich natural heritage of each major bioregion in California. Just recently, at a 2-day meeting at Yosemite National Park, the BLM and other Federal and State agencies discussed with the San Joaquin Valley Regional Association of County Supervisors ways to forge regional strategies and ensure biodiversity protection and economic stability in the region. Also in California in the Klamath Province in the northwestern part of the State, ecosystem planning is now underway in five subregions. Governments are working with the public to develop innovative approaches to deal with complex forestry and wildlife issues that are challenging the region's environmental and economic health.
- The BLM, the USDA Forest Service (Forest Service), and the National Fish and Wildlife Foundation are in the third year of a cooperative aquatic species restoration campaign, called Bring Back the Natives, that emphasizes interagency coordination, watershed management, and improved land use practices to conserve and restore aquatic and riparian habitats on Federal lands.
- In December 1990, the BLM, the National Fish and Wildlife Foundation, 12 additional Federal agencies, and 19 private organizations developed the Neotropical Migratory Bird Conservation Program—Partners In Flight. Neotropical birds are 250 species of the Western Hemisphere's most spectacular birds breeding in North America and wintering south of the Border in Mexico, the Caribbean, and Latin America. One of the most impressive international wildlife programs, Partners In Flight, is examining the causes for population declines, is promoting more ecologically sensitive land management practices, and is restoring habitat for neotropical migratory birds in the United States, Mexico, Canada, and Central America.
- On April 2, 1993, President Clinton convened a Forest Conference in Portland, Oregon. The President directed the Federal land management agencies to provide to him a socially responsive, scientifically sound, ecologically credible, and legally responsible plan addressing growth forest issues such as the controversy over protecting the Northern spotted owl in the Pacific Northwest. A multidisciplined, interagency team developed a series of forest management alternatives for the President's review. The team's key objective was to develop management prescriptions that would safeguard the viability of native species and allow for the

production of a sustainable level of goods and services. Included in the management direction are provisions that limit logging in critically important riparian areas until it is proven that riparian management objectives can be met.

This completes my prepared statement. I will be pleased to answer questions.

DR. DON WALLER

Thank you for the invitation to address you today on issues pertaining to ecosystem management, a topic vital to the biological health of our national forests. I speak to you today as an independent scientist. I have no vested interest in seeing our public forests achieve any particular level of commodity production or particular recreational or aesthetic goals. I speak rather as a trained ecologist interested in how forest management affects plant and animal life, or what we now term biological diversity. I will therefore attempt to speak for this important but unrepresented constituency of yours.

My involvement in national forest management began 8 years ago when several colleagues and I took time from our academic schedules to read draft long-term management plans prepared by the U.S. Forest Service for Wisconsin's national forests. We were shocked by the marginal treatment biodiversity issues received and especially by the serious misunderstanding of ecological science these plans reflected. At the time, we reasoned that these biologically ill-informed plans reflected oversight, gaps in qualified staff, or perhaps the commodity orientation of most planners. We therefore began an earnest effort to fill the conspicuous vacuum in the plans by providing the forests with information on contemporary conservation biology. We assumed that the forest supervisors would appreciate our input and acknowledge its relevance in the final forest plans and environmental impact statements. One forest (after external verification of the legitimacy of our proposals) did attempt to incorporate improved conservation science into their plan even while staff on the other forest remained adamantly opposed. Later, however, progressive elements introduced into the Chequamegon National Forest Plan by the supervisor were mysteriously removed at the last minute in 1986 by the regional forester, behind closed doors and without any scientific or economic review. Again, we were shocked and disappointed that an agency entrusted to conserve so many of our country's lands could be so arbitrary and capricious with regard to the implications of sound conservation science.

These cases were appealed to the Chief who took over 3 years to decide them. Again we were disappointed, again we attempted to negotiate, and again we were forced to pursue legal action to get any fair hearing for modern conservation science. I do not wish to dwell on these failures and disappointments. Instead, I will share the lessons these experiences taught us. These lessons then lead me to make several specific recommendations that I feel could greatly improve the agency's ability to steward our Federal forests more efficiently and effectively.

The first lesson our own experiences taught us is that the U.S. Forest Service cannot be trusted. Promises made by well-informed and well-intentioned officers on one level are routinely overruled at higher levels in the organization, particularly when they affect commodity outputs. Furthermore, such policy decisions are usually made in direct response to lobbying by commercial interests instead of any scientific or economic analysis. This timber orientation is so deeply entrenched within the Forest Service that senior agency personnel routinely and openly encourage higher timber outputs even when these contradict "below cost" criteria set by the administration and threaten natural values.

A second lesson we learned is that Forest Service leaders feel entitled to openly flaunt their responsibilities under NEPA and the NFMA to fully and honestly divulge the environmental impacts of the forestry practices they pursue. In passing these laws, Congress intended to hold Federal forest managers accountable for the ecological and environmental effects of their practices. NFMA remains the only Federal law with any explicit provision to protect native biodiversity, yet Forest Service leaders continue to interpret this diversity provision in a self-serving manner far removed from the consensus of contemporary conservation biologists. Thus, we encounter the present situation where a major Federal agency attempts to escape the public accountability and scrutiny our environmental laws are intended to ensure and the courts are forced to decide major issues of forest policy.

A third lesson we learned is that, while wrapping itself in the progressive rhetoric of new perspectives and ecosystem management, the agency has quietly persisted in continuing to pursue policies that consistently favor high timber outputs over most other natural and recreational values. This is not true on every forest, or on every district, but it is pervasive enough across regions and the National Forest

System as a whole to belie the rhetoric and reveal an agency still primarily wedded to manage our public forests for timber production. Furthermore, the agency has even used progressive rhetoric to cloak its logging orientation as when substantial areas of mostly healthy forest are logged as "sanitary cuts" under the auspices of maintaining "ecosystem health."

ECONOMIC ISSUES

By any measure, the U.S. Forest Service is a massive enterprise. It manages almost one-third of all forest lands in the country, distributed among 156 national forests covering 193 million acres. This is more land than that managed by the Fish and Wildlife Service, the National Park Service, the Army Corps of Engineers, and the Bureau of Reclamation combined. With a budget of over $3 billion for 1990, 39,000 employees, and this extensive land base, it would rank among the largest corporations were it independent. We as a Nation should expect such an agency to be administered with efficient dedication to the goals laid down for by Congress. Unfortunately, this is not the case.

The Act of May 23, 1908 established that counties would receive 25 percent of all gross timber sale receipts from timber sales within their boundaries. This Act has erected powerful economic incentives for local governments to push for increased timber harvesting in the national forests ($235.7 million in 1985 and $497.6 million in 1986). Many communities have become economically dependent on these payments and a strong supply of low-cost timber, blocking legitimate efforts to apply sound ideas from conservation biology to ecosystem management.

The Knutson-Vandenberg Act of 1930 allowed the Forest Service to begin retaining that fraction of its timber sale receipts that it believes are necessary for reforestation. The 1976 National Forest Management Act (NFMA) extended this allowance to include thinnings and wildlife management activities associated with timber sales. Expenditures of K-V funds expanded more than 50 percent between 1975 and 1980 and augmented the Forest Service budget by $186.1 million in 1985. Because it is natural for an institution to seek to augment its discretionary budget, this Act has provided a strong internal incentive to increase timber harvests. In addition, it has favored the increased use of clear cuts since these demand the highest costs of reforestation.

A third law passed in 1964 established the right of the Forest Service to grant "purchaser credits" to build roads, a necessary, but expensive, part of the infrastructure needed to support timber harvests. Under this act, the Forest Service lets timber purchasers deduct the cost of the roads they build from the amounts they pay for the trees to the Forest Service. In 1985, the Forest Service obtained $192.3 million worth of roads in this way in addition to the $234.8 million directly appropriated by Congress for this purpose.

LEADERSHIP AND PERSONNEL ISSUES

Since its inception, the U.S. Forest Service has sought to fulfill two distinct, and, at times, conflicting goals: to conserve and protect the national forests and their natural resources, and to provide a stable and sustainable supply of commodities from those forests. Through time, the former has progressively lost out to the latter for many reasons, including the incentives just mentioned. In response, the Forest Service has encountered a rising crescendo of protest from both the informed public and, more recently, from its internal ranks. While controversy is not new, current storms of protest extend into the daily papers, prime time television, and even the pages of Sports Illustrated. Not surprisingly, these conflicts have also precipitated an identity crisis within the agency regarding what should be their goals and how they should be pursued.

The Forest Service employs many excellent scientists, both in its independent research section and on individual forests. Unfortunately, their opinions are only rarely solicited during key phases of forest planning. Furthermore, even when they are consulted, their opinions are often dismissed or even disallowed. I recently heard a scientist in the Northwest complain that a decision to base management decisions regarding salmonid fisheries in the Tongass National Forest on the best current information then coming from research elsewhere in the Pacific Northwest was summarily overruled in the Washington, DC office in direct response to political pressure. Scientists were told that research done outside of Alaska was irrelevant to the Tongass. In other cases, scientists' opinions are solicited, then ignored. In some cases scientists have even been told to rewrite their opinions to better match agency policy or in response to political pressure. This violates basic norms of scientific conduct and endangers our ability to make informed public decisions regarding our valuable national resources.

Dissatisfaction within the Agency runs so deep that an "Association of Forest Service Employees for Environmental Ethics" was established in 1989. The very existence and popularity of such an organization bears testimony to the atmosphere of intimidation and discord that exists within the Agency. Loyal employees are forced to choose between pleasing their superiors and protecting the resources many feel they were hired to conserve. In November, 1989, all the forest supervisors from the Western region signed a pointed letter to the Chief complaining that "the current emphasis of national forest programs does not reflect the land stewardship values embodied in our forest plans. Congressional emphasis and our traditional methods and practices continue to focus on commodity resources." Regional forester John Mumma also resisted pressure from the Washington office to maintain excessive and nonsustainable levels of timber harvest. As you know, Mumma was forced to accept early retirement shortly thereafter. By this past August, 9 of these 13 supervisors had been transferred, reassigned, or took retirement.

If the Forest Service is to effectively apply ecosystem management, it will need to erect a leadership and command structure that demands respect from its employees, the scientific community, and the public. Because science and management will continue to coevolve as we gain deeper insights into ecosystems, these leaders will need flexibility and imagination as well as trust. It is the role of Congress to make our public priorities and overall commitments clear and demand leadership that reflects these priorities.

ECOSYSTEM MANAGEMENT

Ecosystem management holds out the prospect of improving the stewardship of our vast Federal lands by incorporating modern conservation science and integrating management decisions more thoroughly across our landscapes. In contrast, the Forest Service has persisted far too long in managing the national forests piecemeal, propagating similar patterns of timber harvest over broad areas instead of recognizing distinctive values and acknowledging the conflicts that sometimes exist between alternative uses. Planning generally centers on individual forests, districts, and even opportunity areas rather than the broader landscapes and biogeographical regions that should properly be their focus. This has had the effect of promoting extensive timber harvests, even in lands ill-suited to them or poor in their economic return. At the same time, threats to biotic communities are dealt with on a species-by-species basis, ensuring an ever-growing list of threatened and endangered species. As ecosystem management develops, it must attempt to resolve these conflicts by recognizing the clear advantages to be gained by aggregating similar uses together onto lands best suited for these purposes. Conversely, the conflicts that clearly exist between conflicting dominant uses must be recognized so that they can be effectively segregated. Furthermore, such decision must occur at the broad scales necessary to sustain the ecological processes upon which our forests depend.

Sadly, ecosystem management as practiced thus far by the Forest Service has amounted to little more than another public relations initiative aimed at deflecting public scrutiny and criticism. Small-scale pilot projects are held up as exemplars of ecosystem management, then reversed or negated by decisions made later or for other, usually much larger, areas. In separate, unrelated incidents, I was twice told of episodes where senior personnel from the Washington office sought to reassure audiences that ecosystem management would be limited primarily to demonstration projects and specifically would not affect timber targets or the bulk of on-the-ground management. Such "business as usual" pronouncements belie the public stance of the Forest Service and evidences the deep duplicity that has marked its leadership. In response, the public has become increasingly critical and cynical.

RECOMMENDATIONS

Clearly, many impediments exist to slow or block reform within the Forest Service. Biased leadership, an unbalanced perspective among Forest Service officers, and internal and external incentives favoring timber harvest activities have all conspired to defeat the intent of Congress to redirect Forest Service priorities. Especially the uppermost levels of the Forest Service bureaucracy appear unwilling or unable to enforce legislated mandates to protect noncommodity values.

Do these failures imply that we should dismember the Forest Service, turning lands important for conservation over to another steward such as the Department of Interior? There are those who believe the agency cannot be reformed and advocate this drastic "New Zealand solution" to avoid obvious conflicts in land use. Alternatively, this agency might join the other Federal agencies in embracing not just the rhetoric but the imperatives of ecosystem management.

As the agency has attempted to supply a growing set of competing demands, it has foundered in its ability to provide even marginally efficient economic outputs and basic environmental protection. It has attempted to meet its concurrent obligations via simultaneous multiple use, a concept that has failed to attain either economic efficiency or sustain ecological functions and species diversity. Congress and the Agency should now recognize and accept the substantial economic and ecological advantages to be gained by segregating and guiding competing uses among distinct land areas. This process will demand careful economic and ecological analyses. The scientific community stands ready to assist in these efforts. As a start, I urge Congress to address the following set of conspicuous issues.

- The agency continues to resist congressional direction regarding its basic mission and goals. Despite the MUSY Act of 1960, the NEPA of 1970, and the NFMA of 1976, the agency continues to cut extraordinarily high volumes of timber at low or no return to the U.S. Treasury while failing to protect the basic noncommodity natural resource values entrusted to it. As an agency, it remains stubbornly entrenched in outmoded paradigms of intensive forestry and, in 1993, is still uncommitted to the protection of biodiversity and other natural values. It has thus repeatedly fallen to the courts to decide basic matters of policy that Congress plainly prescribed years ago.

- Failed leadership has created a culture of fear and uncertainty. The failure to heed Congress reflects a leadership committed far more to extracting commodities than to protecting the resources entrusted to it. Leaders of the Forest Service continue to refuse to adjust agency priorities to concur with what the public expects and what Congress has laid down as the law of the land. At the same time, they place extraordinary and often contradictory demands on their subordinates. District and forest personnel often work in an oppressive atmosphere of uncertainty with shifting sets of expectations and obligations. They deserve leaders they can respect with a clear and scientifically informed vision of the job to be done and how to do it. While all decision making should not be centralized, conscientious officers attempting to enforce congressional mandates to protect environmental values should not work in fear of being overruled, demoted or transferred.

- Contradictory incentives skew management goals. A number of laws, institutional habits, and budgetary incentives have interacted to shape Forest Service policy. The current ambivalence in direction stems from the contradictory internal and external incentives agency personnel face. On the one hand, they are expected to promote conservation and the sustainable harvest of forest resources. At the same time, they face strong pressures to maintain high outputs of commodities at low cost. Well-intentioned but now outmoded Acts such as the Knutson-Vandenberg Act tie internal budgets directly to timber harvests in a way that subverts management of the forests. Similarly, payments to counties in lieu of taxes are also tied to logging, ensuring strident local political pressure to sustain high harvest levels. Thus, Congress shares responsibility for the agency's failure to effectively protect environmental goals and must move quickly to remove these perverse incentives.

- Too many budgetary incentives exist within the Forest Service to harvest timber. With incentives like those discussed above, it is not surprising that forest personnel often work to maximize their own budgets rather than returns to the U.S. Treasury or ecosystem sustainability. Through the retention of K-V funds and the construction of purchaser credit roads, one out of every three national forests managed to retain more than 75 percent of their timber receipts in 1985. Congress has fueled this bias by consistently approving Forest Service budgets heavily weighted toward timber-harvest activities (Figure 1). Such actions directly contradict the goals of other legislation Congress has passed specifically to curb the excesses brought about by intensive timber management.

- Line-item appropriations contribute to environmental damage. In setting budgets for the Forest Service, Congress continues to fund activities related to intensive forestry such as road building at far higher levels than those related to conservation (Fig. 1). We cannot expect the Forest Service, even under new leadership, to achieve effective reform in the presence of these perverse incentives. After setting clear goals via legislation and a reliable and consistent set of standards for reaching them, Congress should step back and resist the temptation to micromanage by setting line-item appropriations. In addition, individual members of Congress must resist the temptation to influence policy in individual forests within their districts. Having set policy via collective legislation, Congress should limit its intervention to ensuring that those policies are being carried out.

- Conservation science is ignored. Despite pressures from the conservation biology community, the Forest Service has tarried in applying conservation science to improve the sustainability of its silvicultural practices. Rather than substantially modify its management to better protect biological diversity and other environmental values, the agency has preferred to promote public relations initiatives. The agency should move immediately to inject contemporary conservation science into policy and integrate this science more thoroughly into routine local forest management.

- Planning must occur at appropriate scales. Forest Service planning continues to emphasize the simultaneous pursuit of many competing goals. Such management has the effect of homogenizing forested landscapes by applying uniform, and often intensive, forest management practices to each forest and district. It is far preferable, from both an economic and an ecological point of view, to sequester divergent and incompatible uses among different areas. Some forests and parts of forests are far better suited to timber production than others. Similarly, certain areas are far more important for sustaining biological diversity or serving other noncommodity uses. It is inefficient and impractical to simultaneously manage for disparate uses on the same lands, yet the Forest Service has often sought to do this. To protect the regional diversity of species, ecological communities, and landscapes, it is imperative that Forest Service planning occur at broader scales. Only if planning is hierarchically organized, with clear sensitivity to which uses are most unique and appropriate for each area, will the Forest Service be able to efficiently and effectively achieve the multiple uses that Congress and the public demand.
- A committee of scientists should oversee implementation of ecosystem management. To assure Congress that it will meet the provisions of the NFMA dealing with the conservation of natural communities and species diversity, Congress should establish a committee of scientists to periodically review and oversee the implementation of ecosystem management. Such a committee would simply and cheaply ensure the credibility of these programs while fostering creative solutions to pressing natural resource questions. It would also provide strong incentives to more directly involve scientists and specialists within the agency in the teams making planning and management decisions.

CONCLUSION

Congress is faced with making many important decisions this session regarding human economic and social affairs that demand your serious attention and careful deliberation. I am here to remind you that you also face critical decisions regarding life and death conditions for many other species that share our Nation. You have the opportunity here to better sustain both the economic and ecological values of our public forests, but only if you insist that ecosystem management extend to more than localized demonstration projects. In the long run, it will be far more efficient and practical to protect our natural resources and biological diversity wholesale via ecosystem management than retail, one species at a time, through the Endangered Species Act. Please give these issues the same considerations you grant other pressing human concerns.

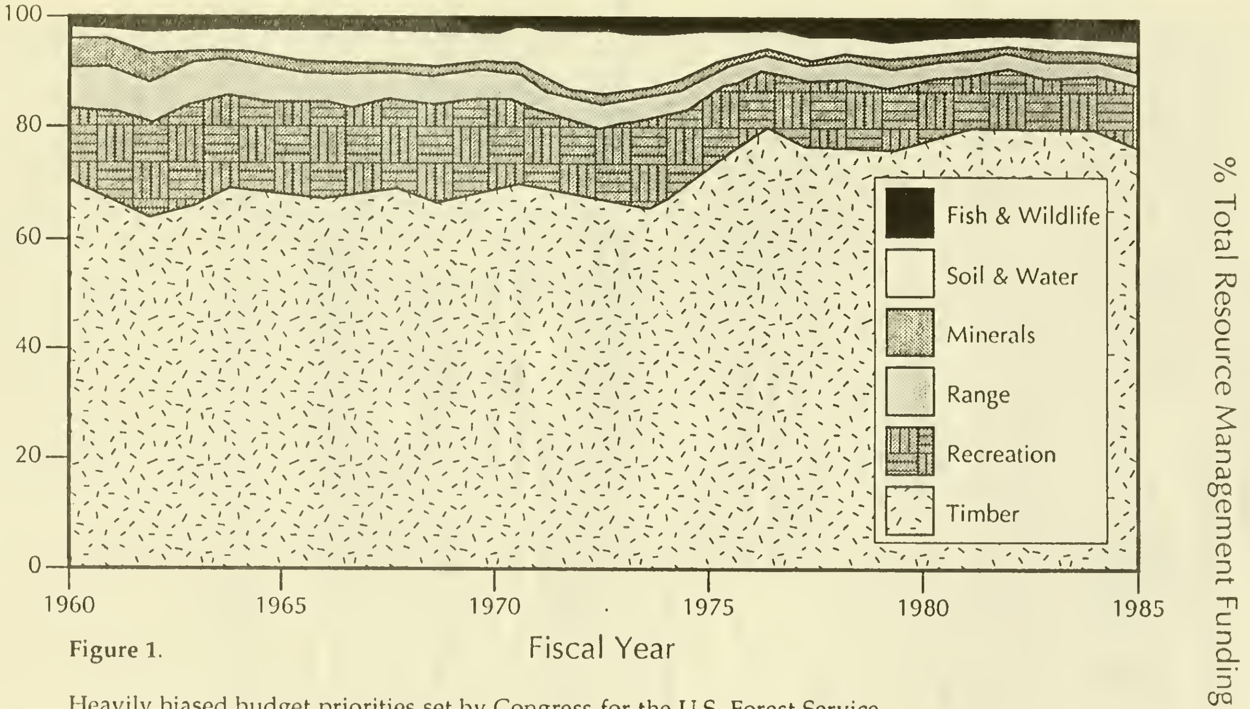

Figure 1.

Heavily biased budget priorities set by Congress for the U.S. Forest Service from 1960 to 1985. Figure from:

Sample, V.A. 1990. The impact of the federal budget process on National Forest planning. New York: Greenwood Press.

Biographical Statement - 1993

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Positions:

1989-present	Professor of Botany and Environmental Studies University of Wisconsin - Madison
1978-89	Assistant and Associate Professor of Botany
1977-1978.	Bussey Post-doctoral Fellow, Gray Herbarium, Harvard University

Education:

Ph.D.	1978.	Princeton University Biology - Population Biology
A.B.	1973.	Amherst College

Fields of Scientific Interest:

Evolution:	Life history theory, breeding systems, and the genetic structure of populations.
Ecology:	Plant demography, reproductive biology, and forest dynamics.
Conservation Biology:	Demography and genetics of rare plants; plant-animal interactions; Effects of habitat fragmentation and ungulate browsingon plant communities.

Other Professional Positions:

Co-chair, Wisconsin Scientific Roundtable on Biological Diversity (for the US Forest Service)
Pop. Biol. & Physiol. Ecol. Review Panel, **National Science Foundation** (1991)
Executive Vice-President, **Society for the Study of Evolution** (1991-94)
Associate Editor, **Evolution** (1994-)
Editorial Board, **Oecologia** (1990-1992)
Board of Directors, **Natural Areas Association** (1989-91)

Students:

I have advised 9 Ph.D. students, several of whom have worked on the demography, genetics, and population biology of rare and threatened plant species.

Publications:

I have just co-authored a book regarding biodiversity and forest management entitled: **Wild Forests: Conservation Biology and Public Policy** (Island Press, Spring 1994). I have also authored or co-authored 44 scientific articles and book chapters and several technical reports, including one for the OTA on biological monitoring in National Forests.

Teaching Experience:

I teach courses in ecology, evolution, and conservation biology, and advise the undergraduate major in Biological Aspects of Conservation. I also helped initiate the UW's M.S. program in Conservation Biology and Sustainable Development.

DR. ALAN A. LUCIER

INTRODUCTION

My name is Alan Lucier. I am a forest ecologist, and Director of Forest Environmental Studies at the National Council of the Paper Industry for Air and Stream Improvement, Inc.

The National Council is a nonprofit membership organization founded in 1943. We provide the forest products industry with research and technical support programs on environmental questions affecting manufacturing and forest management operations. Member companies manage over 60 million acres of timberland, and account for more than 90 percent of the paper and 80 percent of the solid wood products manufactured in the United States.

The National Council's forestry-related programs are addressing environmental questions affecting forest management, timber supply, and forest health issues. Priority research areas include Global Climate Change, Forest Water Quality, Wildlife Biology, and Wetlands (Attachment 1). In addition, we are developing a new program on Forest Management and Forest Health to address and integrate information needs related to ecosystem management and sustainable forestry.

I appreciate the opportunity to appear before this committee to discuss technical concepts and questions related to ecosystem management (EM) for forest resources. My statement will address three main topics: (1) emerging concepts and definitions of EM, and their significant implications for American forestry; (2) a technical basis for EM in the science and traditions of American forestry; and (3) roles and priorities for research to strengthen the technical basis for EM. This statement reflects my professional knowledge and opinions as a forester and scientist.

CONCEPTS, DEFINITIONS, AND IMPLICATIONS

At the outset, we should acknowledge the long and complex history of natural resource management in the United States. This history includes resource exploitation, environmental degradation, ecosystem restoration, sustainable development, and wilderness preservation. It encompasses many dimensions of human experience, from cruelty to compassion, and from tragedy to triumph.

Current ideas and discussions about ecosystem management are emerging in this historical context at a time of intense conflict over natural resources and the environment. This conflict has escalated to an intensity that is damaging industries, communities, and agencies.

The Clinton administration is using the term "ecosystem management" to describe a new process for managing natural resources on Federal lands. Specific implementation guidance does not exist, and is not expected for many months. Some broad concepts are nevertheless taking shape. At a minimum, ecosystem management implies a process by which project-level decisions are influenced by larger-scale ecological planning. An implicit objective is to find an appropriate balance between preservation of natural systems on one hand, and sustainable development on the other. An implicit assumption is that humans cannot avoid decisions about natural resources, and should support those decisions with knowledge of the physical, biological, and social relationships that define ecosystems.

Are these concepts of ecosystem management actually new? Not really. Large-scale planning and balancing preservation with sustainable development have been concerns of the forestry profession for many decades. What is new is the technological, regulatory, and social contexts in which these concerns are addressed. Advances in remote sensing and GIS technologies are providing new information and tools for landscape-scale planning. Regulations and litigation have paralyzed Federal land management, and greatly increased Government involvement in private land management. Changes in public attitudes have focused attention on natural resource issues, and led the forestry profession to reexamine its traditions (11).

Clearly, ecosystem management is a response to new forces affecting management of natural resources on Federal lands. This response has the potential to shape public policies and attitudes toward forestry and forest products, and could have significant implications for private as well as public lands. There is a perception that ecosystem management will produce additional layers of regulation, higher management costs, and excessive constraints on timber supply. This perception has been strengthened by developments in the Pacific Northwest, where ecosystem management has been equated with massive new allocations of public lands to nature preserves, with resulting social and economic impacts.

On the other hand, ecosystem management could provide an opening to more rational debate of forest management policies, and eventually end the seemingly wasteful practice of managing our Federal lands by litigation and appeal. For this to occur, ecosystem management must be more than a disguise for efforts to give primacy to preservation over sustainable development. Ecosystem management should instead be a process for using ecological knowledge more effectively in forest management. To succeed, the process must be tailored to fit the needs and opportunities of diverse agencies and regions. Clear policy guidance from Congress and the administration will also be essential.

A TECHNICAL BASIS FOR MANAGING FOREST ECOSYSTEMS

A technical basis for managing forest ecosystems can be found in the science and traditions of American forestry. Without question, there are many gaps in our knowledge of forest resources, and important weaknesses in our management systems. But there is also an outstanding record of achievement.

In the late 1600s, Sir Isaac Newton was asked how he had been able to make so many important advances in mathematics and physics. In his reply, Newton acknowledged the work of his predecessors, teachers, and peers by saying "If I have seen further, it is by standing upon the shoulders of Giants." Today's forest scientists and managers also have tall shoulders to stand on, and should not ignore the opportunity.

Fraudulent allegations of wholesale failure in American forestry must be challenged. Cooperative efforts of State and Federal agencies, industry, universities, and private landowners have produced an impressive array of technologies and management systems. Accomplishments of American forestry in science, policy, and education have set standards for the rest of the world. There have also been serious failures and many shortcomings. But on balance, the accomplishments outweigh the failures. The proof is in the productivity of our commercial forests, the vastness and splendor of our nature preserves and recreation areas, and the strength of our forest products industry (6). For example:

- The volume of growing stock on United States timberlands increased by 23 percent between 1952 and 1987, despite a 44-percent increase in annual timber removals during the same period (4).
- The ratio of net annual growth to annual removals in commercial forests is about 1.3. With further investments in management, timber production in the United States could be increased substantially on a sustained yield basis (13).
- Wilderness and other protected areas include more than 225 million acres, or 10 percent of the U.S. land area (3).
- On National Forests, more than 40 million acres were in wilderness or other protected areas in the late 1980s. This is about 22 percent of the total National Forest area (12).
- Timber-based industry in the United States employs some 1.6 million people, and accounts for over 7 percent of total United States manufacturing output. The industry ranks among the top 10 employers in 46 States, and has an annual payroll of about $44 billion (1).

Looking back on these accomplishments, American foresters are justifiably proud of their profession. But we also know we must do better in the future. It is entirely appropriate, in my view, that we give greater and more consistent attention to ecological principles. Many of our failures and shortcomings have resulted from focusing too intently on a single method or objective, whether it be in timber production, fire suppression, or spotted owl preservation. We must become more willing to question both our standard assumptions and our new perspectives.

The clearcutting issue offers a good case in point (10). We know that clearcutting is an appropriate harvesting system for achieving some economic and ecological objectives. Properly applied, clearcutting minimizes logging costs, and promotes regeneration of valuable shade intolerant trees such as pines, oaks, and aspens. It also provides habitat for many animals that use the berries, seeds, and dense vegetation that often develop in the bright sun of clearings. In addition, clearcutting eliminates the temptation to harvest only the largest and most valuable trees. This common and destructive practice is known as high grading or dysgenic selection. It leaves the lowest quality trees to grow and reproduce, and is responsible for the poor condition of many hardwood stands in the eastern United States.

Some critics of American forestry argue clearcutting should be prohibited because it inevitably destroys forests. This argument is false and should be rejected. On the other hand, we know that clearcutting has often been applied in ways that are inappropriate for biological or aesthetic reasons. An ecological perspective in forest management may help prevent misuse of clearcutting and other practices.

ROLES FOR RESEARCH

Investments in research will be needed to help translate ecological perspectives into better forest management. Research can provide objective information about current and possible conditions of forests and related systems. Moreover, research can discover and develop new possibilities for producing, balancing, and restoring forest values. Cooperative investigations involving government, universities, industry, and other private-sector groups must play an increasingly important role in providing information needed to resolve conflicts over natural resource issues.

The value of cooperative research in American forestry has been demonstrated repeatedly. At the National Council, we are committed to a strategy of cooperative research in our forestry-related programs.

- In the Northwest, we are working with the Forest Service, BLM, and several universities on studies of spotted owls and cumulative watershed effects.
- In the South, we are collaborating with the Fish and Wildlife Service and others on investigations of black bears, wetlands, and red cockaded woodpeckers.
- In Maine, we are studying effects of forest management on neotropical migratory birds with the Manomet Bird Observatory and several timber companies.
- In the Lake States, we are cofunding studies of global change and wetlands with the Forest Service and the Environmental Protection Agency.

Cooperative research projects like these will strengthen the scientific basis for ecosystem management. These projects are expensive and require some compromises among the cooperating organizations. Benefits of cooperation include better science, more effective use of resources, and broader acceptance of results.

Research can help support ecosystem management, but it cannot determine what values should be produced and sustained in America's forests. The complexity and diversity of forest ecosystems allow multiple pathways to the same objective. Scientists can evaluate the relative merits of alternative pathways, but we have neither the authority nor all the expertise needed to set the objectives. Like other citizens, scientists may choose to participate in the policy debate. But when we do so, we have a special obligation to distinguish between opinions based on our technical expertise, and opinions based on our personal biases and beliefs. Too often, we inflate the significance of our opinions by suggesting they reflect the "best available science," when in fact this best science is mere speculation in support of subjective value judgments.

RESEARCH PRIORITIES

Priorities for research to support ecosystem management of Federal forests are difficult to define in the absence of coherent management objectives and policies. Two scenarios will be presented for purposes of this discussion.

Current trends suggest that timber production might be treated as an incidental benefit of managing for a desired future condition defined as minimum human interference. Under this scenario, we can anticipate continuing decline in timber output from Federal lands, and increasing pressure on supplies from private lands. Minimum management would be both the means and the end. Key research topics would be the economic, social, and environmental effects of constraining Federal timber supplies (2,5,7,8,9). For example,

- What are the likely effects on employment, income, and community stability?
- What will minimum management do to forest health and the risk of wildfire?
- What are the potential impacts on international trade in forest products?
- Can timber supplies from private lands be increased to offset reductions in supplies from Federal lands? What social, economic, and environmental factors might limit production on private lands?
- To what extent will constraints on timber supplies stimulate use of nonrenewable materials in place of wood? What are the environmental implications of product substitution?

An alternative scenario assumes commitment to a new multiple-use policy implemented through an ecosystem management process, with significant involvement of local communities in setting objectives for individual forests. In this case, the research agenda would be much more complex, with priorities varying greatly within and among regions.

As a general strategy, research at the forest and regional levels would evaluate the environmental and economic outcomes of alternative forest management regimes at the landscape scale. Environmental outcomes of interest might include forest health, water quality, wildlife populations, plant community diversity, and aesthetics. Economic outcomes of interest might include site productivity, timber supply, recreation opportunities, employment, and community stability. Research at the national level would focus on technology development; fundamental questions in forest biology and ecology; assessments of supply and demand for timber and other resources; and coordination of outputs and activities of regional and forest level programs.

CONCLUSIONS

To conclude, I would like to reemphasize two points.

First, a scientific basis for ecosystem management of Federal forests can be found in the science and traditions of American forestry. Inadequate consideration and frequent misrepresentation of this science and tradition have been disturbing features of the debate on ecosystem management thus far.

Second, we should renew and strengthen our commitment to cooperative research in American forestry. This commitment has been tested in recent years by funding constraints, rapid changes in priorities, and inadequate separation between scientific and political objectives. These challenges must be overcome so that the proven advantages of cooperative research can be realized.

Thank you for your attention. I would be happy to answer your questions about topics I have addressed.

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[The attachment to Mr. Lucier's statement follows:]

Forest Management and Environmental Quality: Status and Direction of United States Industry's Technical Studies Program

Paper presented at International Environmental Symposium "Pulp and Paper Technologies for a Cleaner World." April 27–29, 1993. Paris, France.

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EXECUTIVE SUMMARY

The U.S. forest products industry is conducting a technical studies program on forestry/environmental questions through its environmental research arm, the National Council of the Paper Industry for Air and Stream Improvement (NCASI). Priorities are set through deliberations of technical committees comprising resource managers and researchers from NCASI member companies. Investigations are targeted to key questions affecting forest mangement, timber supply, and public perceptions of forest products. Areas of emphasis include Forest Health, Forest Water Quality and Wetlands, and Forest Wildlife Biology. A guiding principle is that properly conducted research can help establish a factual basis for rational consideration of the public's concerns about forests and forest management. Moreover, research can reveal new and environmentally beneficial options for managing forests.

INTRODUCTION

Demand for forest products is expected to grow substantially in the future. Wood consumption worldwide is projected to increase from 33 billion cubic meters in 1986 to 4.1 billion cubic meters in the year 2000 (2). In the United States, wood consumption is expected to grow from about 0.6 billion cubic meters in 1986 to 0.8 billion cubic meters in the year 2040 (9).

The United States has the ability to supply a substantial portion of the growth in demand for forest products at home and abroad. This ability derives in part from a potentially abundant and affordable timber supply. The United States currently enjoys a competitive advantage in wood cost relative to most other countries and can maintain that advantage by investing in forest research and management. Economic and biological factors can support substantial increases in annual timber growth rates in the United States on a sustained yield basis without loss of environmentally desirable forest conditions.

Nevertheless, the timber supply outlook in the United States is highly uncertain. Forest management, like many activities, is under intense pressure from citizens and interest groups who are concerned about the environment. As a result, large areas of publicly owned forests have been withdrawn from timber management and allocated to habitat preservation. Concomitantly, State and Federal regulations have begun to impose severe restrictions on the management of private lands. Issues such as wetlands protection, endangered species, and cumulative watershed effects are already major factors affecting both the practice of silviculture and timber harvest. Proposals to regulate forest management to enhance biodiversity and influence global carbon budgets may exacerbate the situation if implemented.

The industry's forest managers have a rapidly expanding need for technical information on forest management and its relationship to environmental quality. In the absence of new technical information, public agencies will continue to base forest management and regulatory decisions on worst-case scenarios. Moreover, there are additional dimensions of forest/environment questions with significant implications for several mill-related regulatory issues. These include:

Air and Energy: Concerns about forest health are often cited as justification for regulatory proposals to reduce emissions of sulfur dioxide, nitrogen oxides, VOC, and "greenhouse gases."

Solid Waste: Increasing constraints on landill capacity have stimulated interest in spreading mill waste on forest lands, which has the benefit of returning organic matter and nutrients to forest soils. This option may be restricted by concerns about possible adverse effects on forest wildlife and water quality.

Wetlands: Concerns about wetlands have become important factors affecting the construction or expansion of manufacturing facilities and associated waste treatment/disposal sites. Some mills are using constructed wetlands to polish effluent from conventional wastewater treatment systems.

"Environmental Friendliness": Forestry-related concerns are often cited in assessments of the overall environmental impacts of the forest products industry. For example, supposed impacts of forest management have figured prominently in the ongoing debates about (a) "plastic vs. paper" and (b) the net effect of the forest products industry on global carbon budgets.

ROLE OF NCASI IN ADDRESSING FOREST/ENVIRONMENTAL QUESTIONS

Forestry-related investigations have been part of the National Council's technical studies program since the late 1970s. At that time, the industry identified a need for technical information on nonpoint source water pollution from forestry operations. The industry turned to NCASI to organize the necessary investigations. Results have been useful in responding to issues related to the Federal Clean Water Act, State forest practice regulations in the West, and nonregulatory, nonpoint source control programs in the South.

Since 1980, the number and complexity of forest/environment issues have increased dramatically. Currently, NCASI is conducting forestry-related investigations in five major program areas: (a) Air Quality/Forest Health, (b) Global Change, (c) Forest Management Practices/Water Quality, (d) Wildlife Biology, and (e) Forest Wetlands. These programs are coordinated by the Operating Committee's Forest Environmental Studies Task Group, which comprises high-ranking forest managers and researchers from member companies. The annual budget for 1993 is about 1.7 million dollars.

Coordination of industry and nonindustry research is a high priority in all of NCASI's forestry-related programs. Cooperative relationships have been established with several Government agencies and universities. These relationships help cooperating scientists understand the industry's concerns and often lead to Government and university projects that help address industry information needs. Additional benefits include: (a) reduced cost of investigative activities through cost-sharing arrangements and (b) more rapid integration of research findings into policy decisions.

A guiding principle of NCASI's forestry-related programs is that research results can help establish a factual basis for rational consideration of the public's concerns about forests and forest management. Some of these concerns are legitimate and must be addressed to ensure the health of forest ecosystems, maintain productivity, and increase public acceptance. Other concerns are based on emotional responses to timber harvest and on untested hypotheses that have been misrepresented in order to promote political causes and special interests. The untested hypotheses must be identified and tested with scientific rigor so that policymakers can base decisions on facts while recognizing the emotional part of stridently voiced concerns. If properly conducted, research will explore questions whose answers can lead to new and environmentally beneficial options for managing forests.

AIR QUALITY/FOREST HEALTH

Coordinated research organized by NCASI and other organizations has shown that assertions of pervasive forest decline in the eastern United States were without scientific basis. Results indicate that acidic deposition is not a significant near-term threat to commercial forests in North America, and that ozone is the pollutant of greatest concern with respect to possible chronic effects (1).

Currently, NCASI is addressing unresolved questions about possible chronic effects of air pollutants on forests. Field and laboratory studies have demonstrated subtle but measurable responses of plant tissues and soils to ambient levels of ozone and acidic deposition. A key scientific challenge is to develop data and models that will support credible quantitative assessments of long-term effects on forest health and productivity.

NCASI is continuing support for a limited number of key investigations, and continuing to monitor the scientific literature. Currently, the latter task is especially important because many papers are now appearing as products of investigations started in North America and Europe during the late 1980s. New findings may have a significant bearing on several air and energy issues of importance to the pulp and paper industry. These include (a) regulation of emissions from industrial facilities in the vicinity of wilderness areas and national parks, (b) ambient air quality standards for ground-level ozone, and (c) "critical load" limits for nitrogen and sulfur deposition to protect sensitive ecosystems.

GLOBAL CHANGE

Research on forests and global change is in an exploratory phase. Predictions of catastrophic and near-catastrophic impacts of predicted climatic changes are somewhat reminiscent of the acid rain controversy in the early to mid-1980s. Proposed Government responses to the global change issue could have significant implications for timberlands management and likely have a major influence on future research and policy agendas.

NCASI's Global Change Program began in 1991. Investigations areaddressing two main topics: (a) role of U.S. forests and forest products industry in the global carbon budget, and (b) potential effects of climate change and rising CO_2 concentrations on forest resources.

Initial results of carbon budget studies include:

- Annual emissions of CO_2 from U.S. forest products manufacturing facilities are approximately equal to annual net uptake of CO_2 by industry-owned forests in the United States.
- In most cases reported in the scientific literature, forest harvesting followed by reforestation did not cause significant reductions in soil carbon. This result contradicts what has been commonly assumed in global carbon models and some heavily publicized assessments (4).
- Soil carbon storage can be increased through management practices that improve tree nutrition and increase forest productivity (4).

Continuing studies are quantifying (a) current and potential carbon storage in forests, forest products, and wastes, (b) effects on net CO_2 emissions of using wood-derived products in place of nonrenewable alternatives, and (c) effects on net CO_2 emissions of using energy from wood-derived waste in place of fossil fuels.

Potential effects of global change on forests are being investigated in close cooperation with the U.S. Forest Service Global Change Program. Cofunded studies are developing fundamental information needed to test and refine models of the response of commercial tree species to rising CO_2 and climate-related stress factors. In addition, NCASI is supporting critical evaluations of forest response models that have been the basis of government agency projections of serious climate change impacts on forest resources. These evaluations suggest it may be feasible and necessary to develop peer review guidelines and minimum standards for models of forest response to climate change.

FOREST WATER QUALITY

The NCASI Forest Water Quality Program develops and applies technical information needed to (a) achieve water quality and stream quality objectives in managed forests, and (b) resolve current and anticipated conflicts between forest managers and regulatory agencies. NCASI staff bring technical expertise and an appreciation of industry concerns to many multiagency committees at the State, regional, and national levels.

A major objective has been to support development, validation, and implementation of "best management practices" (BMPs) to minimize effects of forest management on erosion and sedimentation, surface water temperature, and water chemistry. Cooperative efforts of industry, government, and academia over several decades have identifed basic BMPs such as stream bank protection that provide significant benefits at reasonable cost. Implementation of basic BMPs provides adequate protection of water quality in most circumstances, i.e. fish populations and beneficial uses are not significantly affected. Special additional control measures beyond basic BMPs may be necessary in situations where there is greater than normal risk of water quality impacts (e.g., in areas with high risk of landslide).

Failure to implement BMPs is perceived to be the most common cause of forest water quality problems in most areas. Current studies are evaluating alternative approaches to achieving high implementation rates. BMP compliance monitoring and continuing education for loggers and landowners appear to be essential in both regulatory and nonregulatory programs. Regulatory programs have high costs, both for Government administration and logger/landowner implementation. Impacts of regulatory programs on fiber supplies and costs can be significant, and may be affected by mill-specific factors. For example, impacts may be greater than average for mills that draw from timberlands with large amounts of wetlands, steep terrain, or other site types that might be affected by special management restrictions.

While interest in BMPs remains strong, there is also increasing interest in landscape-level assessments of forest management and water quality. These assessments may involve several related concepts, including (a) watershed analysis and planning, (b) cumulative effects, and (c) waste load allocations among point and nonpoint sources. NCASI has been tracking research and regulatory developments since the early 1980s, and began an investigative program on cumulative watershed effects (CWEs) in 1991.

An important development in 1992 was completion of a report outlining NCASI's technical approach to evaluating CWE's and addressing key research questions (5). A screening level of evaluation is used to assess watershed sensitivity, evaluate existing conditions, document the existence of important downstream watershed values, and define how changes in hydrologic processes caused by forest management activities link to downstream watershed values. A second level of analysis is needed when the screen predicts the existence or risk of unacceptable cumulative effects that cannot be controlled by management solutions.

Response to the NCASI CWE methodology has been very favorable. At least one company has already applied the methodology and found it to be effective. Moreover, the concepts developed in the methodology are having a positive influence on the development of State-mandated CWE programs.

FOREST WILDLIFE BIOLOGY

Regulations and court decisions intended to protect the northern spotted owl have become predominant factors affecting timber supply in the Pacific Northwest region of the United States. Throughout the Nation, interest is increasing in questions related to biodiversity, habitat preservation, and threatened and endangered species. This interest has been heightened by the current national debate about proposed changes in the Endangered Species Act.

NCASI is addressing a wide range of forestry/wildlife questions in the major timber producing regions of the United States. The overall goal is to provide a sound experimental basis for forest management alternatives that maintain satisfactory wildlife habitats while minimizing costs to the forest products industry.

Emphasis in the West is on the population status and habitat requirements of the northern spotted owl, with additional work on elk, goshawks, and marbled murrelets. NCASI field investigations have shown that spotted owls often live and reproduce in older, second growth forests; thus it appears feasible to provide owl habitat in managed forests. Moreover, high risk of stand-replacing wildfire in some owl habitat areas suggests that active management may be beneficial to the long-term survival of spotted owls in some circumstances.

High priority topics in the East and South include (a) red cockaded woodpecker, (b) black bears, (c) neotropical migratory birds, and (d) wildlife habitat relationships in forest wetlands. In all regions, NCASI is providing technical support on a variety of biodiversity issues affecting the management of public and private forests.

WETLANDS

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (8). They provide important ecological and economic benefits, and are regulated as "Waters of the United States" under provisions of the Federal Clean Water Act. Increasing regulatory pressure and an unreasonable landward expansion of 'jurisdictional' wetland boundaries have placed wetlands near the center of a national debate on the limits of Government control of private property.

There are many ecological types of wetlands, several of which are important sources of timber for forest products. The U.S. industry is concerned about increasing regulatory constraints on forest management activities in wetlands. NCASI is working to provide technical information needed to determine how wetlands can be managed for timber production while protecting other wetland functions and values.

Field studies are underway in nine States to determine forest management effects on wetland water quality, hydrology, wildlife, and plant communities. Preliminary results indicate that effects of forest management on wetland water chemistry are generally minor and transient. Effects on wildlife habitat will take longer to evaluate. On-site changes in the abundance of some species are expected immediately after harvest and have been documented in the literature. Some preliminary results regarding the long-term compatibility of forestry and wildlife in wetlands are encouraging, however.

- An extensive survey of wetland crossings for forestry access in Pennsylvania indicates little or no difference between upstream and downstream sample locations in indices of habitat quality and channel condition.
- An intensive survey of wildlife in North Carolina pocosins revealed similar numbers of species in plantations vs. unmanaged areas, although there were some differences in species composition: 65 species were common to both plantations and unmanaged habitats; 18 species were found exclusively in unmanaged pocosin; and 27 species were found exclusively in plantations (6).

The Wetlands Program is providing technical support to the industry on wetland regulatory issues. These include (a) wetland definition/delineation, (b) development of special State water quality standards for wetlands, and (c) policies and programs to achieve the national "no net loss of wetlands" goal.

FUTURE DIRECTIONS

Regulatory trends emerging from forestry/environmental concerns and related scientific output reflect attitudes to consider landscape-scale planning, including larger wilderness and wildlife reserves, as the optimal means of maintaining biodiversity and restoring ecosystem integrity. The U.S. forest products industry has adopted a set of Forest Management Principles, and is prepared to demonstrate that timber production can be compatible with the maintenance and enhancement of other forest values (3). This task is complicated greatly, however, by increasing demands that forest managers demonstrate not only stewardship of individual sites but also collective stewardship of forested landscapes (Appendix 1).

An important research priority is to develop a practical framework for accounting the environmental costs and benefits of alternative forest management regimes. A first level of analysis might involve consideration of physical, chemical, and biological interactions among several forest management operations and environmental components (Appendix 2). This first level is analogous to the inventory phase of a life cycle assessment (7). It will require unprecedented levels of collaboration among technical disciplines and effective coordination of industry efforts with those of Government resource management agencies and research organizations. Defining appropriate spatial and temporal scales for cost/benefit inventories will be a formidable task.

A second level of analysis might involve interpreting cost/benefit inventories for alternative management regimes in terms of their implications for "forest health," "sustainability" of forest ecosystems, and overall "environmental quality." Moving to the second level requires consideration of the uses and fate of forest products, as well as questions of equity among groups with different subjective values and economic interests.

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APPENDIX 1. EXAMPLES OF LANDSCAPE-SCALE QUESTIONS ABOUT FOREST MANAGEMENT AND FOREST HEALTH

EFFECTS OF "FOREST FRAGMENTATION" ON WILDLIFE POPULATIONS

Some ecologists believe forest management harms wildlife populations by "fragmenting" forests into small and isolated "patches" of habitat. Researchers have developed methods for calculating indices of forest fragmentation, and are attempting to determine relationships between fragmentation and the abundance of selected species. Such relationships are being incorporated in models of population viability and risk of species extinction.

BIODIVERSITY PRESERVATION

Environmental groups and Government agencies have lists of areas where they feel forest management should be prohibited or restricted to protect biodiversity. Planning for biodiversity protection raises many technical questions. These include (a) what criteria are being used to identify and prioritize areas considered important to biodiversity, (b) where are the areas located, and (c) what models and assumptions are being used to estimate the benefits and costs of additional protection?

HARVEST SCHEDULING RESTRICTIONS BASED ON CONCERNS ABOUT CUMULATIVE WATERSHED EFFECTS AND BIODIVERSITY

Landscape-scale issues like cumulative watershed effects and biodiversity have stimulated interest in the spatial and temporal distribution of timber harvest activities within landscapes. Regulators and advocates of "new forestry" are developing a variety of prescriptions that would restrict the size and spatial distribution of harvest units. Researchers are developing GIS-based harvest scheduling models that can select stands for harvest within environmental constraints. There is a need for technical analysis of these prescriptions and models, and their implications for environmental quality and timber supply.

Appendix 2. Matrix of Interactions Among Forest Management Operations and Components of Environmental Quality.

Operation	Environmental Component			
	Air Quality	Water Quality	Soil Fertility	Wildlife and Biodiversity
Seedling Production		X		
Slash Burning	X	X	X	X
Mechanical Site Prep.		X	X	X
Chemical Site Prep.		X		X
Plantation Establishment		X	X	X
Chemical Weed Control		X		X
Fertilization		X	X	X
Thinning		X		X
Prescribed Burning	X	X	X	X
Final Harvest		X	X	X
Log Storage/Transport		X		

DR. CHADWICK D. OLIVER

THE BASIS OF ECOSYSTEM MANAGEMENT

Several terms have been used to describe the recent direction of United States forest management. The overall objective is perhaps best summarized by the United Nations definition of Sustainable Development:

> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
>
> —Brundtland Report 1987, United Nations.

Applied to forest management, it means all species (biodiversity) and soil productivity are to be maintained for present and future values while allowing humans to benefit from the forests.

The scientific basis of forest management is currently caught in a shift from one theory (paradigm) to a dramatically different one. The definition of ecosystem management and how biodiversity are best preserved differ dramatically with theories. Of broader importance are how the public, management agencies, and the political system adjust to changing theories of science.

This paper will first describe the changing theories of ecosystems, how they effect the definitions of ecosystem management, and how specific management considerations and values are affected. It then discusses the general problem of the public's adjusting to new scientific theories, legislative considerations, and research needs.

CHANGING SCIENTIFIC THEORIES OF FOREST ECOSYSTEMS

Steady state theory: Until recently, forest communities were thought to exist naturally in a benign "steady state," sometimes associated with "climax" or "old growth" forests (Stevens 1990). The different species were assumed to be coevolved, interdependent, and had lived in stable conditions, with individual trees dying and being replaced by others in a relatively benign, constant manner. Disturbances were considered external to the system, usually artificial, and generally harmful. The steady state forest was assumed to be most conducive to stability and diversity. Preservation of all species, it was believed, could be practiced by maintaining the forest in a "natural," old condition either by avoiding human intervention or by mimicking the alleged natural process by "uneven age" management. Recent variations of this theory accept wind, fire, and other disturbances as real, but believe nature will create forest patterns and processes so different from human activities that human intervention other than to preserve forests will be irrevocably harmful to the natural system.

Constant change theory: Within the last few decades, this steady state concept has gradually been losing scientific credibility (Figure 1), and the steady state theory is presently not the predominant theory. It is now accepted that many large and small disturbances periodically occur to forests and there is no stable, natural condition (Sprugel 1991). Forests regrow through a succession of structures (Figure 2; Oliver 1981). Each structure is suitable for some plant and animal species and not for others. As the structure changes through growth or disturbances, plant and animal populations change through migration, growth, dormancy, and death. Forests of various structures were somewhat randomly distributed across the landscape before human populations increased.

Natural disturbances included wind, fire, floods, insect outbreaks, and combinations of these and other disturbances. They left a kaleidoscope of structures across the landscape. Some areas were extremely denuded of vegetation and wood, eroded, and depleted of nutrients where reburns or hot fires occurred several years after a windstorm. Other areas contained snags and down logs. Still others contained only an understory—with a destroyed overstory. Others contained only an overstory with a destroyed understory; and still other areas may have been missed by the disturbance.

Large areas with similar structures were created where disturbances were very large; and certain plant and animal populations increased dramatically. As the structure changed, other plants and animals were favored and many previous populations declined—through migration, death, or dormancy. Many forest areas have continuously cycled through large disturbances and regrowth, creating repeated booms and busts in populations. Where large areas of low human population existed, relatively stable populations of plants and animals were maintained as periodic, random disturbances ensured that all forest structures were represented in the landscape.

Pollen records and other evidence show that the larger plant and animal species found in natural forests did not coevolve into a closely interdependent "superorganism" Because of climatic changes, slow genetic turnover, and plant and animal spe-cies migrations, the species associated with the human perception of "natural forests" have not been together long enough for this coevolved interdependency to have occurred. In addition, climatic change and natural disturbances have created so much random variation in natural forests that any forest species currently alive has necessarily survived under a variety of past conditions. It is only the extreme losses of forest structures for habitats which have caused species to become endangered or extinct. Such losses have occurred at various times in nearly all structures—the ivory billed woodpecker when old river floodplain forests are lost; the kirtland's warbler when the stem exclusion structure is lost in jack pine stands; the grouse when open areas are lost in New England.

Attempts to preserve forests by excluding natural disturbances or by excluding even-aged management have endangered species which depend on early post-disturbance forest structures. Similarly, excessive even-age harvesting while not allowing old growth structural features have endangered such species as the red cockaded woodpecker, the ivory bill woodpecker, and the spotted owl.

DEFINITIONS OF ECOSYSTEMS, ECOSYSTEM MANAGEMENT, AND LANDSCAPE MANAGEMENT

Several definitions apply to the various terms, depending on scientific theory and author:

Ecosystem: An ecosystem can be considered either an "interdependent" group (steady state concept) or an "interrelated" group (constant change concept) of organisms and their environment. In any case, ecosystems can be quite varied in size and temporal extent (Kimmins 1987). A single rotting log or the entire earth can each be considered an ecosystem.

Landscape: A landscape is a spatially contiguous area and its biotic and abiotic components. Landscapes vary in size. At different times, a landscape has been considered a subdivision of ecosystems (considering large ecosystems) or a combining of many ecosystems (considering small ecosystems).

Ecosystem management: The merit of ecosystem management is that it emphasizes the interrelation of the various species and processes to be managed. Ecosystem management is distinctly different from historical, commodity-based management, where the production of commodities rather than the maintenance of patterns and processes is the primary goal.

Ecosystem management would maintain all of the many patterns, processes, and species, rather than emphasizing a few commodities or a few species. Ecosystem management has been used in two, contrasting ways. One way is based on the steady state theory, while the other way is based on the constant change theory.

1. *Steady state ecosystem management:* One concept of ecosystem management was developed by the Forest Ecosystem Management Assessment Team which assisted President Clinton's Forest Plan (FEMAT 1993). This plan referred to old growth as an ecosystem, and developed ways to manage large areas (millions of acres) to maximize patterns and processes of old growth species.

This concentration on only the old growth structure of the forest process relies on the steady state theory (described above). Species which may become endangered if non-old growth habitat is not maintained were assumed either not to exist, to be able to live in small gaps in the old growth, or to exist in geographically distinct (mostly non-Federal) areas.

The FEMAT ecosystem management definition also minimized human manipulations to create desirable structures (and so commodity extraction is minimal or nonexistent). Natural disturbances are assumed to occur at temporal and spatial scales which will maintain all patterns and process. Large reserve areas are advocated where natural patterns and processes are assumed to maintain this old growth condition with limited human activities.

2. *Constant change ecosystem management:* The alternative approach has been used by various groups (e.g., Johnson and Agee 1987, Salwasser et al. 1992; American Forest Association 1993; Everett 1993). It considers ecosystem management as managing ecosystems in ways compatible with both ecological processes and human needs.

This approach recognizes the constant change theory of forest development and advises active silvicultural manipulations to mimic, avoid, and/or recover from natural disturbances to maintain all natural patterns, processes, and species across the landscape in patterns within natural variations. Maintaining forests within this variation will involve removal of timber and other products, employment, and other values as byproducts of these efforts.

Landscape Management: Landscape management is the application of the constant change theory of ecosystem management to specific landscape areas. It involves integrating the coordination of changing forest stand structures to maintain all habitats and reduce risks of uncontrollable natural disturbances. This coordination is done through integrating biological knowledge with a technical information system and a variety of field silvicultural operations. The coordination also includes accounting for different landowners and their concerns and objectives through a system of incentives and regulations.

Differences in the steady state and constant change approaches to management, and their underlying philosophies, become clearer when specifics of management are considered. These specifics include:

- maintaining biodiversity;
- dealing with imperfect knowledge of ecosystems;
- ensuring a balance of conditions are maintained;
- accounting for other human values.

MAINTAINING BIODIVERSITY

Maintaining stable populations of all species by managing for the species individually is an impossible task. There are too many species, including some not yet known; and their requirements for survival are unknown. Alternatively, biodiversity can be promoted by maintaining the habitats in which species are found. In forested areas, these habitats are the various stand structures.

By the steady state theory, biodiversity can be promoted by leaving forests in natural, old growth conditions. Modifications of this theory advocate that natural disturbances will maintain the balance of structures for habitats if large areas are protected from human intervention.

By the constant change theory, stand structures constantly change through disturbances and regrowth (Figure 2). The present forest areas is smaller; and forest areas are currently dissected by farms, highways, and urban areas. Consequently, animals may not be able to migrate to areas of suitable structures if large, natural disturbances and forest regrowth change the habitat in their present location. The balance of structures which was maintained over large areas by natural booms and busts in plant and animal populations may not be achieved naturally with present human populations and forest uses.

Two methods have been suggested to maintain a diversity of stand structures:

Large Natural Reserves Approach: Set aside large reserves to be protected from all disturbances or to allow only natural disturbances; and,

Landscape Management Approach: Manage forests so each landscape area contains an acceptable balance of all stand structures.

Increasingly large natural reserves are advocated by those adhering to the steady state theory. Much smaller natural reserves are often incorporated into constant change ecosystem management as National Parks or Wilderness Areas.

Large natural reserves approach: Natural reserves are found in national parks and similar preserves in many countries. These preserves may offer large areas of older-stand structures to balance younger structures often maintained in managed forests—providing the preserves are not so geographically isolated from managed forests that species may actually be lost in either because of a lack of a balance of structures. As these parks become older and the stands age, it is becoming increasingly difficult to keep natural disturbances out. Management then depends on a costly program of protection and recovery from natural catastrophes. When and where economic conditions are harsh, such human uses are difficult to prevent. A diversity of structures and species may or may not be maintained, depending on the area's size, the natural disturbance sizes, and the random pattern of disturbances.

Landscape management approach: A diversity and balance of stand structures can be maintained across the presently smaller and more dissected forest areas by managing forests so each landscape area contains an acceptable balance of all stand structures. This method would quickly achieve a balance of stand structures across large areas—an important consideration since many forests do not presently contain a balance of structures. The variety of structures would reduce the risk of a single natural disturbance destroying the entire area.

Management to achieve and maintain the balance of structures (for habitats) will require changes from past forest management. Forest management would shift to manipulating the growing forest so it creates the appropriate structures at given times to fit the targeted landscape pattern. Silvicultural operations would accomplish the desired changes in structures.

Many silvicultural operations would be used in ecosystem management to mimic, avoid, and recover from natural disturbances. The silvicultural operations would avoid the extremes of loss of property, life, and a balance of habitats often associated with natural forest disturbances. Where there are insufficient amounts of a given structure to achieve a balance across a landscape area, it means there is an excess of another structure (Figure 2); and active silvicultural operations would be used to create as many features of the structure in short supply as possible rapidly by manipulating the excess structure (Oliver 1992a,b,c). Landscape management has sometimes been misinterpreted to imply removal of old growth forests and replacing them with young forests which look like old growth. In fact, if there are insufficient amounts of old growth—or any other structure—the structure in short supply could be maintained—and preserved better through active protection.

Uneven-age management would be a necessary tool where more open (stand initiation) structures are not needed, but more old growth structures are needed (for example for thermal cover or habitat for species which need old growth conditions which are in short supply.) On the other hand, various forms of even-age management would be necessary where there is a shortage of open areas and species requiring this habitat are in jeopardy.

DEALING WITH UNCERTAINTY OF NEEDED STRUCTURES TO MAINTAIN ECOSYSTEMS

There is uncertainty of what structures and processes to maintain to ensure biodiversity is preserved. There are two approaches to dealing with this uncertainty:

1. Doing nothing in the face of this imperfect knowledge; or,
2. Managing to ensure the entire range of conditions found in nature is maintained across the landscape.

Steady state approach: Doing nothing is based on the antiquated steady state or climax concept that forests will naturally return to a benign equilibrium if left to themselves. In fact, there is little reason to believe that forests will return to any equilibrium point (or a past, idealized equilibrium point) if nothing is done. Since forests constantly grow and are destroyed, doing nothing may cause important structures (and species) to disappear for lack of activity.

Constant change approach: In light of incomplete knowledge about what structures are needed, the conservative approach is to use active management to ensure at least minimal amounts of all structures across each relatively small climatic, soil, and biologically uniform area. In this way, there would be maintenance of open areas (stand initiation stage), closed forest areas (stem exclusion stage), uneven-aged forest areas, old growth areas, and others. To be conservative, management would maintain all structures even if no presently known endangered species needed it.

Managing to ensure a range of conditions is distinctly different than past commodity management, where few silvicultural tools were used (often clearcutting in some regions, and selective cutting in other regions). The difficulty is determining what structures and patterns are important.

There are two ways to determine the needed structures:

1. Determine the biological requirements of each species in the ecosystem. This is a time-consuming, difficult, and probably impossible task, although all progress toward such knowledge would help ensure vital structural components are not accidentally lost. Unless a balance of species with conflicting habitat requirements (stand structures) are considered simultaneously, the conservative nature of specialists may exaggerate the amount of habitat needed for each species.

2. Determine the natural patterns and variations of disturbances and other processes and the resultant patterns.

Maintaining the natural patterns and variations through silvicultural management—and improving knowledge of patterns to be maintained through knowledge of individual species—will probably best ensure all species will be maintained. We have learned very much about disturbances, stand development, landscape patterns, and needed structures in the past one hundred years (e.g., Toumey and Korstian 1937, Lutz and Chandler 1946, Baker 1950, Kimmins 1987, Hunter 1990, Oliver and Larson 1990). In addition, natural disturbances never did or will provide a uniform or predictable set of structures; consequently, we know that existing species were somewhat adaptive in their forest structure requirements. For these reasons, exacting structural conditions will probably not be necessary to ensure all species will survive. (For example, an exact spacing, number, or size of snags or down logs is probably not as necessary as providing various amounts of snags and down logs at some places in the landscape.)

The exact pattern of and amount of each structure needed for optimum balance of species is not known (and may in fact need to fluctuate somewhat); however, the extreme excesses and shortages of structures can be modified through silvicultural operations while more is being learned through adaptive management.

ENSURING BALANCES OF CONDITIONS ARE MAINTAINED

Forest management has tended to reduce biodiversity and create other problems when a single (or narrow range of) management practices were applied constantly over a large area, whether by a central mandate or by other reasons. These problems have occurred in parts of the Pacific Northwest where clearcutting was applied almost exclusively; on the other hand, in some Rocky Mountain and southeastern hardwood areas, too much uneven-age management has led to problems.

While it may seem appropriate to manage Federal lands through large reserves if it balances the non-Federal lands managed on commodity management, such a balance would only be effective if:

1. There were appropriate mixes of Federal and non-Federal lands within each local ecological unit to ensure all structures were maintained within each climatic, soil, and biological unit; and,

2. The non-Federal landowners would guarantee that ALL other structures would be maintained on their lands; and,

3. various insects, diseases, fires, soil degradation, and other factors would never occur in the preserved stands on Federal lands.

These three conditions rarely, if ever, occur in the United States. An alternative is to provide for balance of conditions on all land ownerships, through various incentive systems (Lippke and Oliver 1993).

TRADEOFFS OF BIODIVERSITY AND OTHER ECOSYSTEM VALUES

Forests provide a variety of human values. Some of these values are discussed below. The effect of the two interpretations of ecosystem management on these other values is shown on Table 1.[3]

Biodiversity: Biodiversity refers to the variation in life forms, genetic makeup, biological processes, and ecological niches. Maintaining stable populations of all species by managing for the species individually is an impossible task. There are too many species, including some not yet known; and their requirements for survival are unknown. Alternatively, biodiversity can be promoted by maintaining the habitats in which species are found. In forested areas, these habitats are the various stand structures.

Commodity management has generally promoted just those forest habitats and structures which were compatible with efficient commodity production. In places, efficient production emphasized uneven-age management; in other places, even-age management.

Which approach to ecosystem management will best provide biodiversity (Table 1) depends on which theory is believed.

Global environment: If wood products are not produced from areas where other ecosystem values are maintained, they will be produced from elsewhere in the world where ecosystem values are disregarded—with greater harm to the global environment. Or, more polluting products such as steel, aluminum, concrete, brick, and plastic will be used as substitutes for wood products (Kershaw et al. 1993). Constant change ecosystem management which produces wood products in ways compatible with other ecosystem values is very beneficial to the global environment. (In fact, managing for biodiversity can actually create wood products of higher quality—and so greater substitution value for steel, concrete, etc.—than traditional commodity production.) Steady state ecosystem management which reduces wood commodity production has a negative impact on the other global environment.

Cost to the public: The public's ability to pay for various ecological values through taxes (or foregoing taxes through reducing commerce) is limited. Where more tax money is spent to obtain ecological values in one area, less money is available to provide protection of ecological values in other areas. Constant change ecosystem management would cost much less (and produce more tax revenue) than steady state ecosystem management through protection and recovery from natural disaster (including road construction). Constant change ecosystem management with joint production of commodity and noncommodity values (Lippke and Oliver 1993) would cost somewhat more than simply commodity production management.

Employment: Unemployment is a public cost, which reduces the ability to spend taxes on other environmental values. In addition, forest ecosystems are generally more diverse where human economic well-being is above the subsistence level and local people have an active interest in maintaining the forest in an ecologically sound condition. Constant change ecosystem management would provide much employment both in forest operations to maintain the balance of stand structures and through remanufacture of high quality wood products produced. Steady state ecosystem management would provide few jobs, except those provided through taxes. Commodity production would provide an intermediate number of jobs.

From Table 1, it can be seen that all other values are minimized if the steady state approach to ecosystem management is used. The constant change approach provides many more of the other values. The importance of deciding between the constant change theory and the steady state theory, therefore, is important for biodiversity and many other values.

The goal of constant change ecosystem management would be the maintenance of a dynamic balance of forest structures through silvicultural manipulations as growth and disturbances constantly changed the balance. Commodities such as timber would be a byproduct of maintaining the balance, rather than an independent goal. Jointly producing commodities and other values—including employment—in this way will prove to be economically efficient. Maintenance of these structures could provide economically efficient employment and a relatively steady, sustainable flow of a variety of kinds of wood—including very high quality wood.

THE GENERAL PROBLEM OF ADJUSTING TO CHANGING SCIENTIFIC THEORIES

The forest management issue brings up the much deeper social issue of how society adjusts to changes in scientific theories. Generations had passed before society accepted such changed theories as: the earth revolving around the sun (instead of visa versa), "bleeding" sick people did not cure them, and Darwin's evolution. Given present population levels, pressures on the earth's resources, and the inevitability of very destructive fires in forests, a more efficient way to incorporate new theories would seem appropriate. The incorporation of new theories occurs at different rates among several groups: scientists, the public, managers, and politicians.

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[3] See page 60.

Scientists: Scientists specializing in forest development have generally accepted the new, constant change theory (Figure 1), although it often takes generations for those elder scientists who have not abandoned all aspects of the older theory to loose their influence. Scientists specializing in related or peripheral fields often do not keep up to date in theories except in their own specialty. Theories in related fields are incorporated after a new generation recently trained in related fields emerges. Scientists specializing in general teaching—e.g., high school teachers—often perpetuate old theories where they can not keep current on all new theories.

Public: The public's incorporation of new theories depends on the information they receive. Lobbyists, news reporters, public officials, scientists, and politicians speaking as scientific authorities can influence the public's acceptance of scientific theories.

Managers: Public and private managers with responsibility to achieve an end result are often most quick to adjust to latest theories, since their ability to achieve the result depends on correct practices. If encumbered with regulations or directives which restrict how practices are to be done (rather than end results), the managers can only incorporate new scientific theories at the rate allowed by politicians.

Politicians: Political laws dictating which scientific theory was correct have led to ridiculous consequences, such as the persecution of Galileo for disagreeing with the "politically correct" theory that the sun revolved around the earth.

Where political laws do not dictate which theories are correct, decisions often are made in court and are based on "expert witnesses"—scientists with various opinions. As with laws, judicial decisions are often awkward, such as the decision against the theory of evolution in the 1925 Scopes "monkey" trial in Tennessee.

Scientific advisory groups can help influence public opinion and give politicians alternative ways to deal with theories if they are public, unbiased, and allow rigorous discussion of ideas.

SPECIFIC LEGISLATIVE CONSIDERATIONS FOR ACCOMPLISHING ECOSYSTEM MANAGEMENT

Management for biodiversity and other values can be achieved and implemented immediately, effectively, and robustly across many forest conditions and ownerships through the appropriate approach. The approach will involve several things:

Defining objectives: It will probably be most appropriate for laws to mandate forest management objectives rather than practices to achieve the objectives. Appropriate objectives may be:

1. Managing for maintaining a relative balance of all species so that no species (or "genetic swarm" of rapidly evolving species) becomes threatened with extinction, with special emphasis on threatened and endangered species; and,
2. Within this balance, managing for commodities and other human values.

The means to achieve these objectives (whether termed ecosystem management or anything else) are left to the creativity and flexibility of local managers. The exact means can be accomplished most effectively with this flexibility, since different areas will require dramatically different management activities to maintain a balance of forest structures and habitats. Since all species must be maintained, some balance of structures will be required; this balance will require active management in some cases and preservation of some forest types in other cases.

Decentralized organizational approach: Centralized planning and management directions—such as necessary where means rather than objectives are legislated—has been shown extremely ineffective by the collapse of the Soviet Union. Central planning relies on the creativity of a few planners, who simply cannot anticipate all conditions. Consequently, others in the system use their creativity to circumvent inefficiencies created by the central planning.

Alternatively, the success of the free enterprise system is because it allows each person to utilize their creativity. This creativity can be utilized in forest management by giving local managers common goals and the resources and freedom to achieve them as efficiently as possible.

As one suggestion, this "bottom-up" management style could work similar to the United States income tax system:

1. Each local manager would be responsible for managing for the common goal of biodiversity, but could solicit advice from technical and scientific experts;
2. A group of "auditors" would occasionally inspect various local managers, both to offer constructive criticism and to stop any willful deviations from the objectives.

This decentralized management approach would also avoid unattainable quotas imposed by central management, such as occurred through the forest planning process. Upper levels of organizations will be used to coordinate among local managers, so they do not unintentionally act at cross purposes. (See also Interagency Coordination, below.)

The decentralized management approach could be implemented within weeks, thus avoiding long delays which are biologically, socially, and economically harmful. I have trained midcareer foresters (State, Federal, and private) through short courses for many years in landscape management approaches. Teaching landscape approaches to management requires a shift to a different way of thinking; however, local managers learn the different way quite readily—and are very creative in its implementation.

The decentralized approach could be implemented at the same time (rather than after) landscape management tools, complete inventories, and desired balances of stand structures are fully developed. Most landscapes contain such extreme imbalances of structures that some silvicultural activities could begin to reduce the known extremes while more detail is being developed. This reducing extremes would be better for biodiversity and social values than waiting for more perfect knowledge. Forest operations proceed slowly enough that relatively little change would actually occur to the landscape as a whole before more sophisticated tools and detailed directions are developed.

Role of science and scientists: Decentralized management and decisionmaking with target objectives will change the role of scientists from central authorities in management, courts, regulatory teams, or legal processes to experts who advise managers on how best to achieve their common goals.

Reducing costs by joint production of noncommodity and commodity values: The cost of silvicultural operations to achieve the various structures can be high if other values are not provided simultaneously (Table 1); in addition, local people will often circumvent regulations and not protect forest structures from which they do not receive any perceived benefit. Consequently, providing many commodity and noncommodity values from each structure (Figure 4) will help gain local support and offset the cost of creating and protecting the balance of structures.

One important commodity is timber. By thinning stands in the stem exclusion structure (Figure 2), management creates low quality logs, employment, wildlife habitat in the understory reinitiation structure, and (later) high quality logs (Figure 5). High quality logs are an environmentally important substitute for steel, aluminum, brick, concrete, and plastic (Kershaw et al. 1993).

Below-cost timber sales are often the result of joint production, where other values are created at the same time timber is harvested. The other values can include employment, stand initiation or other structures (depending on silvicultural system used), protection from fires or insect epidemics by altering the stand structure, or access for recreation or fire protection. Below-cost timber sales are therefore a way to produce ecological values at a low cost.

Interagency coordination: A strong role of politicians and upper level managers is to ensure that local public and private managers are not encumbered by directives and Federal, State, and local government rules and laws which work at cross purposes. For example, State worker safety laws often conflict with laws to leave snags for woodpeckers in logging operations. High industrial insurance rates discourage many silvicultural operations, and—on private lands—force shorter harvest ages for forests. The endangered species act discourages private landowners from creating habitat for endangered species, since the landowner will lose ability to harvest the timber if an endangered species occupies the habitat. (The Internal Revenue Service has taxed a landowner on the harvestable value of the inherited spotted owl habitat, even though the timber could not be harvested.) Clean air acts reduce managers' abilities to create and manage controlled fires, making wildfires and completely uncontrolled smoke more likely. State forest practice boards could encourage management for biodiversity on private lands; however, these boards are empowered to regulate, not to create incentives for landowners. These incentives are far more effective at achieving the various ecological and social values (Lippke and Oliver 1993). Where public or private landowners do not receive income from various values, the lands can become refuges for unlawful activities such as marijuana growing or stealing of timber, firewood, Christmas trees, or mushrooms.

The various conflicts among agencies develop through ignorance and neglect. To keep the laws from being contradictory, it may require a public decision to identify forest values as a target segment of the United States economy, followed by detailed examination and rewriting of pertinent legislation, to create a the most favorable climate for management of forests for biodiversity. Such targeting and rewriting could produce extremely favorable results for maintenance of biodiversity, other commodity and noncommodity values, and employment at economically very efficient conditions.

RESEARCH NEEDS

Ecosystems research: Much funding and emphasis has been placed on biological research of ecosystems for the past 25 years. It is now recognized that knowledge which can be gained about natural systems is infinite; we will never know everything. Ecosystem research has helped supplement an already large biological information base; and continuation of such research will improve the management base.

Ecosystem research can aid maintenance of a balance of forest habitats if it concentrates equal effort on all structures, patterns, processes, and species—rather than the most charismatic ones such as old growth forests.

Other research areas necessary for effective ecosystem management have not been as well funded recently (e.g., Figure 6; Oliver 1989).

Ecosystems (landscape) management research: Relatively little funding and subsequent work has been done on organizing and managing stands on a landscape so they will maintain balances of structures and habitats. Areas of needed research include:

1. Landscape management information tools which integrate satellite images, inventories, Geographic Information Systems, computer forest projection models, and silvicultural decision keys;
2. Adaptive management techniques which allow rapid development and incorporation of new knowledge without waiting for forests to grow;
3. Social, economic, and policy research.

Silvicultural operations and equipment research: Relatively little has been done in R&D to develop tools and techniques which can efficiently manage the forests for the desired structures. Such tools include equipment for thinning, pruning, and harvesting; tools for creating hollow snags; aerial logging systems for avoiding roads; efficient ways to control wildfires and manage prescribed fires; and others.

Forest commodity research: Costs of managing forests for biodiversity are reduced where biodiversity is combined with producing commodities to help pay management costs (Figure 4 and Table 1). Public landowners will maintain each structure at less cost (or more benefits) as more valuable commodities are obtained from that structure. Research into commodities which increases their ease of management or usefulness (and value) to society will reduce the cost (and increase the incentives) for a landowner to grow forests for many ecological values.

For example, if high quality wood (Figures 4 & 5) becomes more valuable through R&D which expands its uses, there are more incentives to thin stands to create the understory reinitiation and old growth structural features rather than clearcut trees while still small and of low quality in the stem exclusion' structure. (This higher quality wood is also an environmentally valuable substitute for more polluting steel, aluminum, brick, concrete, and plastic [Kershaw *et al.* 1993].)

Achieving ecosystem management on non-Federal lands: It may be appropriate to consider ways to encourage similar management on non-Federal lands at the same time as on Federal lands, since most species do not understand human-imposed property boundaries. Management on non-Federal lands can be done with far less harm to the economy and the public treasury and with far more benefits through appropriately planned incentives than through regulations. At present, however, the forest practice boards responsible for forest practices on private lands are not empowered to give incentives—only to regulate. It will require an adjustment within and among agencies to allow incentives to be effective.

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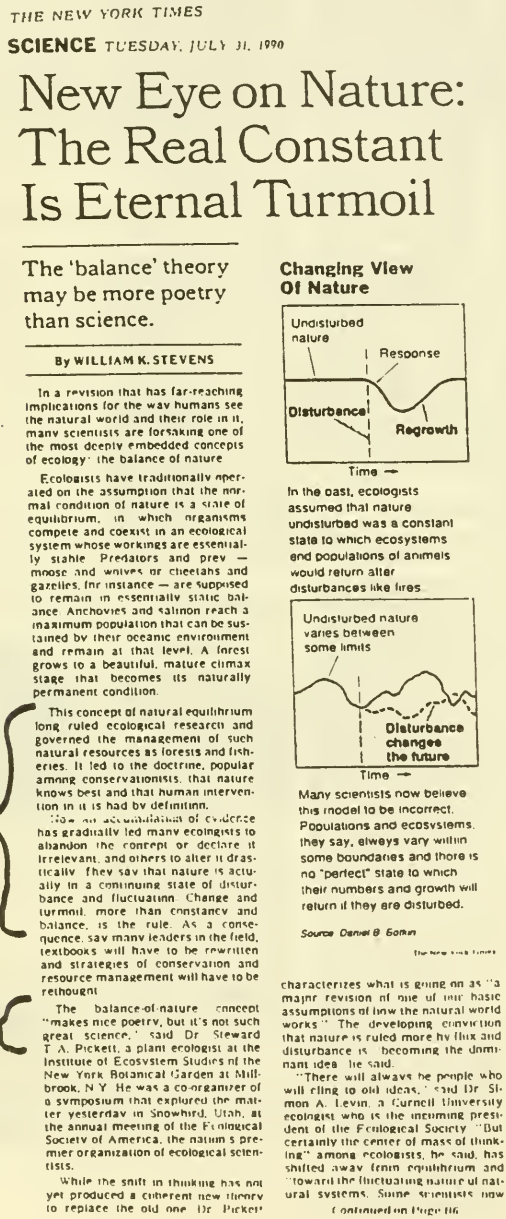
TABLE 1.—EFFECT OF TRADITIONAL COMMODITY MANAGEMENT OF FORESTS AND TWO INTERPRETATIONS OF ECOSYSTEM MANAGEMENT ON VARIOUS VALUES.

	Management Process		
	Commodity	Steady State	Constant Change
Values:			
Biodiversity	1	?	?
Global Environment	2	1	3
Low Public Cost	3	1	2
Employment	2	1	3

NOTE: Ranking: "1" provides lowest positive benefit and "3" provides highest positive benefit.
"?"—If the steady state theory is accepted, this process would rank highest (3) and constant change" would rank second (2). If the constant change theory is accepted, this process would rank highest (3) and steady state would rank second (2).

Figure 1. Our scientific concepts of how forest ecosystems behave have changed dramatically over the past few years, from one of "natural equilibrium", "human intervention is bad", and "balance of nature", to "constant disturbance and fluctuation." Many of our ecological concepts and management approaches are based on the old way of thinking.



THE NEW YORK TIMES

SCIENCE *TUESDAY, JULY 31, 1990*

New Eye on Nature: The Real Constant Is Eternal Turmoil

The 'balance' theory may be more poetry than science.

By **WILLIAM K. STEVENS**

In a revision that has far-reaching implications for the way humans see the natural world and their role in it, many scientists are forsaking one of the most deeply embedded concepts of ecology: the balance of nature.

Ecologists have traditionally operated on the assumption that the normal condition of nature is a state of equilibrium, in which organisms compete and coexist in an ecological system whose workings are essentially stable. Predators and prey — moose and wolves or cheetahs and gazelles, for instance — are supposed to remain in essentially static balance. Anchovies and salmon reach a maximum population that can be sustained by their oceanic environment and remain at that level. A forest grows to a beautiful, mature climax stage that becomes its naturally permanent condition.

This concept of natural equilibrium long ruled ecological research and governed the management of such natural resources as forests and fisheries. It led to the doctrine, popular among conservationists, that nature knows best and that human intervention in it is bad by definition.

Now an accumulation of evidence has gradually led many ecologists to abandon the concept or declare it irrelevant, and others to alter it drastically. They say that nature is actually in a continuing state of disturbance and fluctuation. Change and turmoil, more than constancy and balance, is the rule. As a consequence, say many leaders in the field, textbooks will have to be rewritten and strategies of conservation and resource management will have to be rethought.

The balance-of-nature concept "makes nice poetry, but it's not such great science," said Dr. Steward T. A. Pickett, a plant ecologist at the Institute of Ecosystem Studies of the New York Botanical Garden at Millbrook, N.Y. He was a co-organizer of a symposium that explored the matter yesterday in Snowbird, Utah, at the annual meeting of the Ecological Society of America, the nation's premier organization of ecological scientists.

While the shift in thinking has not yet produced a coherent new theory to replace the old one, Dr. Pickett characterizes what is going on as "a major revision of one of our basic assumptions of how the natural world works." The developing conviction that nature is ruled more by flux and disturbance is "becoming the dominant idea," he said.

Changing View Of Nature

In the past, ecologists assumed that nature undisturbed was a constant state to which ecosystems and populations of animals would return after disturbances like fires.

Undisturbed nature varies between some limits
Disturbance changes the future
Time →

Many scientists now believe this model to be incorrect. Populations and ecosystems, they say, always vary within some boundaries and there is no "perfect" state to which their numbers and growth will return if they are disturbed.

Source: Daniel B. Botkin

The New York Times

"There will always be people who will cling to old ideas," said Dr. Simon A. Levin, a Cornell University ecologist who is the incoming president of the Ecological Society. "But certainly the center of mass of thinking" among ecologists, he said, has shifted away from equilibrium and "toward the fluctuating nature of natural systems. Some scientists now

Continued on Page B6

(Fig. 1, cont.)

New View of the Balance of Nature Finds the Real Constant Is Turmoil

Continued From Page B5

say that ecological communities of plants and animals are inherently unstable largely because of idiosyncratic differences in behavior among communities and individuals in them. A super-aggressive wolfpack leader, for example, can greatly increase the pack's hunting efficiency and destabilize the ecosystem — just as the death of a pack leader can promote instability by causing the pack to disperse.

But even if ecological communities do display some sort of internal equilibrium, many scientists believe, external disturbances like climatic change, year-to-year variations in weather patterns, fires, windstorms, hurricanes and disease seldom, if ever, give the communities a chance to settle into a stable state. In this view, the climax forest, the neatly symmetrical predator-prey relationship and the bumper fish population become transient conditions at best, even in the absence of human intervention.

Scientists are finding this to be true on many scales of time and space, from the glacial and global to the seasonal and local, and in parts of the world long considered the most pristine and stable, like the tropical rain forests of South and Central America, for instance, or the north woods of Canada and the northern United States.

In the natural landscape, "there is almost no circumstance one can find where something isn't changing the system," said Dr. George L. Jacobson Jr., who, as a paleoecologist at the University of Maine, studies ecological change as it is revealed in ancient sediments and rocks. And while there may be a tendency toward a stable equilibrium, he said, "it's never allowed to get there, so we might as well not expect it to exist."

In this developing new perspective, humans are emerging as just one of many sources of ecological disturbance that keep nature in a perpetual state of uproar. The question of whether humans should intervene in natural processes is moot, ecologists say, since humans and their near-human ancestors have been doing so for eons and ecological systems around the world bear their indelible imprint.

The supposedly pristine rain forests of Latin America, for instance, owe some of their character to the intervention of humans who planted and transplanted trees and other plants throughout the jungle. And the supposedly unspoiled Serengeti plain of Africa, some ecologists are convinced, owes its tremendous abundance of grazing animals at least partly to human-set fires that created savanna habitats.

The real question, ecologists say, is which sort of human interventions should be promoted and which opposed.

One of the biggest human interventions, some say, is taking place now as people pour heat-trapping chemicals, mainly carbon dioxide, into the atmosphere. Many climatologists expect that this will cause the Earth's climate to warm significantly, causing especially widespread ecological dislocation.

The temperature of the earth has shifted up and down many times in past eons, ecologists point out, and ecosystems have always adjusted. But this human intervention, scientists say, threatens to force, in a century or less, vast climatic and ecological changes that have usually taken millennia. Ecologists fear that this time ecosystems will not adjust rapidly enough to stave off catastrophe for many species.

Moreover, some ecologists say, people are eliminating some of the diversity of habitat — and therefore of species — that other natural disruptions create and promote. "We threaten that variability because we want to manage everything like cornfields," said Dr. Julie Denslow, a tropical ecologist at Tulane University. There is, she said, "a whole camp of us" opposed to this "horrible homogenizing."

A Difficulty

Posing a Question: What Is Natural?

The new view of nature poses difficulties for conservationists and environmentalists who want to preserve things in their natural condition, scientists say, since the question now becomes: If change is constant, what is the natural state?

What, for instance, is the natural condition of the Adirondacks, where a spirited argument is going on about whether "rough" fish like suckers, shiners and chubs should be killed and removed from some ponds to make way for trout. People on one side of the argument, citing a state policy that aims to "perpetuate natural aquatic ecosystems" in the area, say that the rough fish represent the natural condition and that the ponds should be preserved in that condition. Others say that at least some rough fish are descendants of baitfish brought in by humans and that they have crowded out trout that flourished there earlier.

Is either of these alternative conditions "the" natural state? Or is the natural state the way the Adirondacks were when Europeans first arrived? Or, for that matter, the way they were in the millennia when the region was buried under an ice age glacier? Or in the succession of different forests, animals and ecosystems that followed?

"Nature can be in many conditions," said Dr. Daniel B. Botkin, an ecologist at the University of California at Santa Barbara who is a leader of the reassessment effort. Because of that, he said, conservationists and resource managers will be required to analyze a given situation more carefully than in the past and then choose which natural condition to promote, rather than simply insist that humans should not upset a supposed balance of nature.

"I think he's right," said Rupert Cutler, the president of the Defenders of Wildlife, a major conservation organization. He said that the shift in thinking "suggests that the responsibility for protecting nature will require a much higher level of intense application of science than it was ever assumed to require in the past."

Empty Theory

Observations Find No Neat Balance

In its classic formulation, the balance-of-nature concept holds that an ecosystem maintains a constant equilibrium and, when disturbed, it returns to its former status when the cause of the disturbance is removed.

Many scientists now say it is clear that this is not the way things work.

"We can say that's dead for most people in the scientific community," said Dr. Peter L. Chesson, a theoretical ecologist at Ohio State University who took part in yesterday's symposium along with Dr. Pickett, Dr. Jacobson, Dr. Botkin and Dr. Denslow. The other participants were Dr. Margaret B. Davis, a paleoecologist at the University of Minnesota who helped organize the symposium, and Dr. Judy L. Meyer, a stream ecologist at the University of Georgia.

Many observations of the behavior of animal populations in the wild, says Dr. Botkin, do not support the assumption of neat balance predicted by traditional ecological theory. One aspect of the theory says that when a population of animals moves into an area, it grows gradually to a level of abundance at which its environment will allow it to be sustained indefinitely, and then remains at that level. Another says that predator and prey populations in a given ecosystem oscillate in numbers, with one population at a peak while the other is at a low point and vice versa, thereby creating an equilibrium over time.

But in real life, says Dr. Botkin, "when you introduce a population to a new area, it goes up and then crashes, and then it doesn't remain constant. The long-term numbers vary and are much lower" than predicted by the theory. Similarly, he said, a number of studies and observations, in the laboratory as well as the wild, show that predator-prey populations do not oscillate stably and predictably. Instead, they either fluctuate wildly and unpredictably or the prey species is eliminated and the predator species dies of starvation. In one famous experiment, paramecium microbes increased rapidly. When predatory microbes were introduced, they increased, too. But in the end, the paramecia were exterminated and the predators died of starvation.

Attempts to apply the classical equilibrium principle to the management of marine fisheries led to disaster, according to Dr. Botkin. For years, he said, international regulators of commercial fishing determined allowable annual catches by calculating maximum sustainable yields according to equilibrium theory. The theory was such a poor guide, Dr. Botkin said, that population after population of commercial fish suffered catastrophic declines in the 1950's and 1960's, and some have not yet recovered.

Managers of fisheries are trying to move away from that strategy now, he said, by analyzing the more complicated factors that actually determine fish populations. Among these, for example, are the environmental disturbances that largely determine the size of a given year's hatching of young fish. By estimating and keeping track of these varying "year classes," managers hope to adjust catch quotas year by year and avoid wiping out an entire class.

Some scientists are not quite ready to abandon entirely the concept of an inherent tendency toward equilibrium in ecosystems. A kind of equilibrium, they say, may exist on some scales of time and space.

Scale, in fact, may be very important. While there may be enormous imbalancing disturbances and fluctuations among small populations in small ecosystems, says Dr. Pickett, the fluctuations may be dampened when the larger picture is considered, where a sort of medium-scale equilibrium might apply. An animal population that fails in one environment might not do so if allowed to range over a wider area. Dr. Botkin also said it is quite possible that while a given locality's ecology would change markedly over thousands of years, there could be recurring similarities — and thus a kind of floating equilibrium — at medium-range time scales.

That, in fact, is what Dr. Chesson, the theoretician, postulates. There may, for instance, be a limited range in which an animal population fluctuates over several hundred years. An equilibrium could be calculated by taking the average of the fluctuations. But it would be a "real mistake," said Dr. Chesson, to equate this with anything "remotely like the classical idea of the balance of nature."

Constant Change

Outside Factors Shape Ecosystems

Perhaps the most outstanding evidence favoring an ecology of constant change and disruption over one of static balance comes from studies of naturally occurring external factors that dislocate ecosystems.

For a long time, says Dr. Meyer of the University of Georgia, these outside influences were insufficiently considered. The emphasis, she said, was "on processes going on within the system," even though "what's happening is driven by what's happened outside." Ecologists, she said, "had blinders on in thinking about external controlling factors."

Climate and weather appear foremost among these factors. By studying the record laid down in ocean and lake sediments, scientists know that climate, in the words of Dr. Davis of the University of Minnesota, has been "wildly fluctuating" over the last two million years and the shape of ecosystems with it. The fluctuations take place not only from eon to eon but also from year to year and at every scale in between. "So you can't visualize a time in equilibrium," said Dr. Davis.

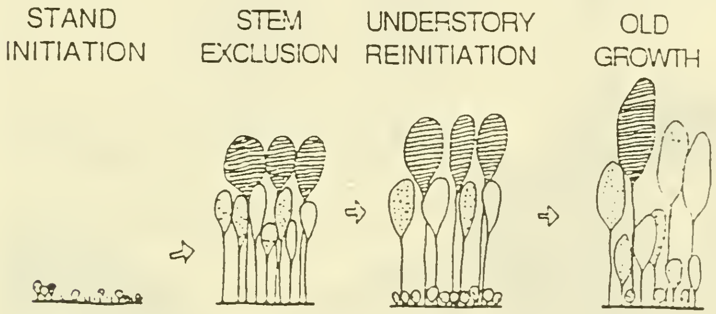
Dr. Jacobson said there is virtually no time when the overall environment stays constant for very long. "That means that the configuration of the ecosystems is always changing."

Figure 2A (after Oliver 1992b). Forest structures change after natural and human disturbances, as shown here simplistically (after Oliver 1981).

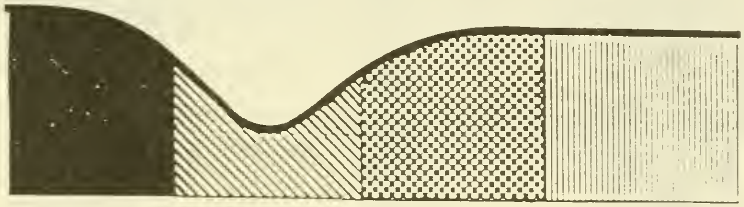
2B. Different plant and animal species are found in each structure, but all structures are necessary within a forest area to maintain biodiversity. (Vertical axis = number of mammal species; after Franklin et al. 1986).

2C. The structures change with age (shown here schematically for western Washington); however, the time before each structure was reached following a natural disturbance varied greatly.

A. CHANGES IN STAND STRUCTURES FOLLOWING DISTURBANCES



B. MAMMAL SPECIES UTILIZING EACH STRUCTURE



C. PRE-1850 WESTERN WASHINGTON FORESTS

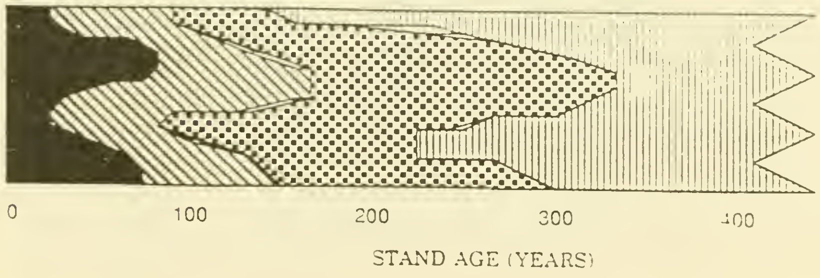


Figure 2. A targeted variety stand structures (Fig. 3C) could be maintained in a dynamic balance across a landscape unit through silvicultural operations. The size of the landscape unit and each stand would be determined by scientists and professionals based on ecological, geomorphologic, and climatic processes as well as logistic considerations. Target spatial distributions of structures would also be defined by scientists.

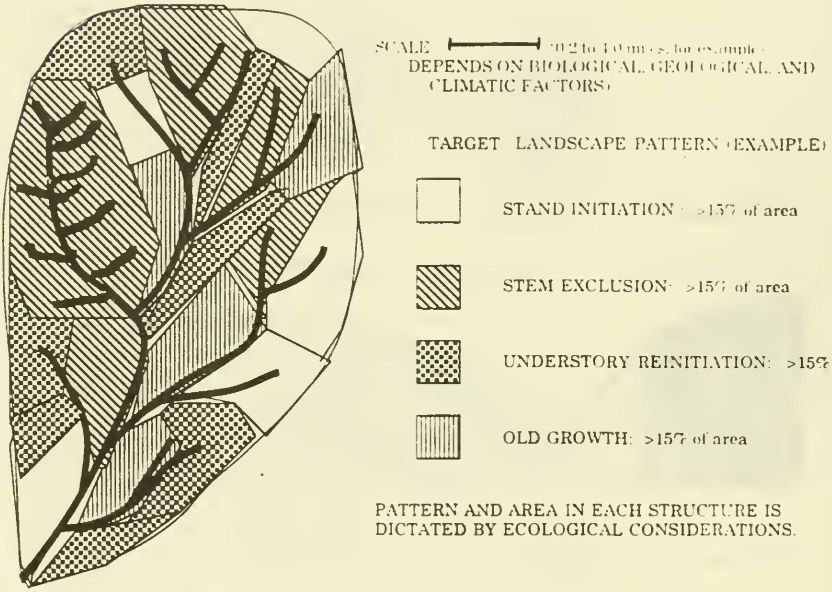
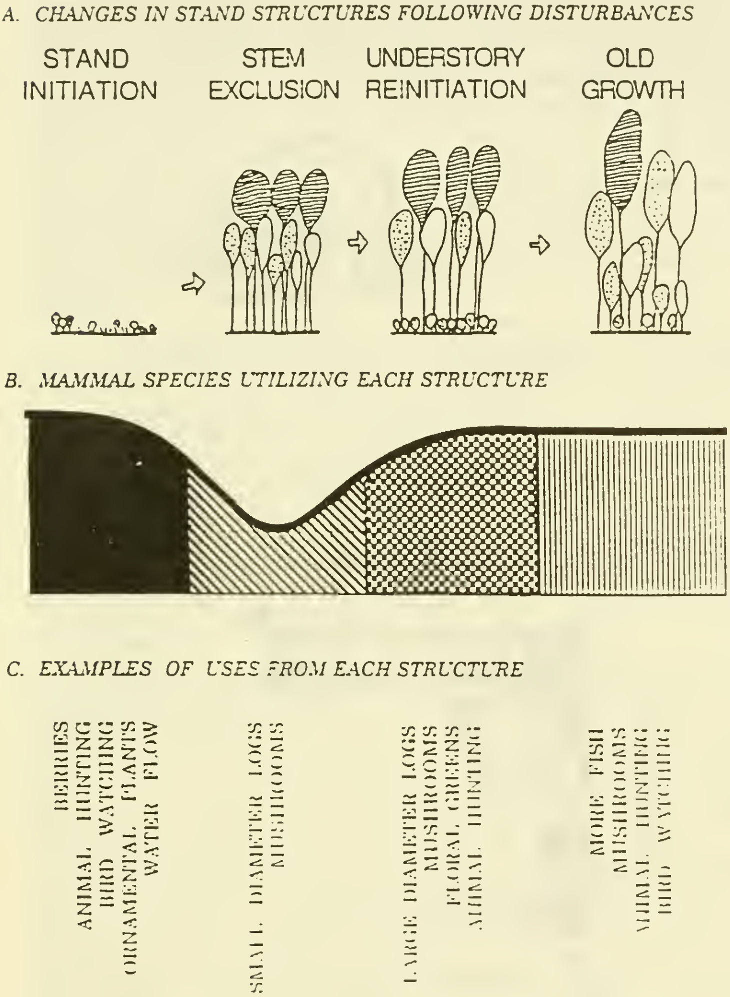

SCALE (0.2 to 1.0 miles, for example)
DEPENDS ON BIOLOGICAL, GEOLOGICAL, AND CLIMATIC FACTORS)
TARGET LANDSCAPE PATTERN (EXAMPLE)
STAND INITIATION: >15% of area
STEM EXCLUSION: >15% of area
UNDERSTORY REINITIATION: >15%
OLD GROWTH: >15% of area
PATTERN AND AREA IN EACH STRUCTURE IS DICTATED BY ECOLOGICAL CONSIDERATIONS.

Figure 4. By maintaining a diversity of habitats across the landscape through silvicultural manipulations, many values can be obtained from the forest. These diverse values can increase rural jobs and wellbeing. A variety of incentives/regulations/approaches are needed to encourage the landowner to create and maintain these structures across a landscape.

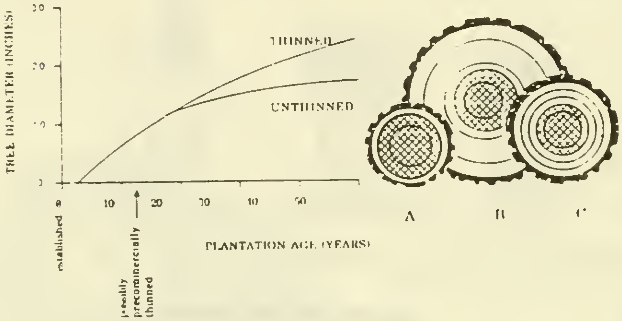

A. *CHANGES IN STAND STRUCTURES FOLLOWING DISTURBANCES*

B. *MAMMAL SPECIES UTILIZING EACH STRUCTURE*

C. *EXAMPLES OF USES FROM EACH STRUCTURE*

Figure 5. Thinning can increase amount of wood available at present and can increase future wood quality, creating more present jobs in thinning operations and future jobs in secondary manufacture of high quality products. If thinning is not done, relatively low quality products for low value uses are grown.

If the young stands (Figure ~~1~~ 2) are thinned before they grow old, small logs with wide rings and primarily juvenile (low strength) wood (A) will be removed in the thinnings and the remaining trees will grow large (B). If the plantations are not thinned, small diameter logs (C) with little mature wood outside the juvenile core will be the primary product of the overcrowded stands. Promotion of thinning and pruning will increase a diversity of habitats (Figure 1) and ensure high quality, large diameter logs in the future. (Hatched areas represent juvenile wood.)



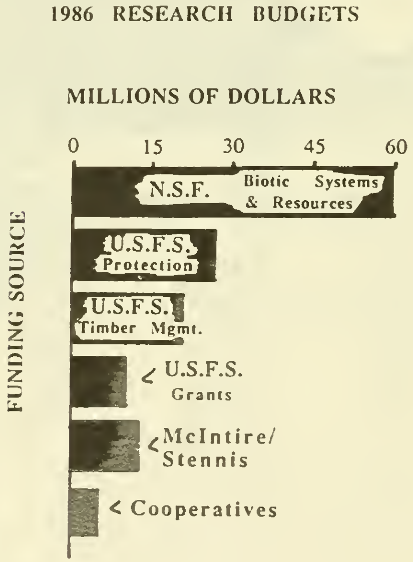


Figure 6. Many traditional sources of funding for forestry research--U.S.Forest Service, McIntire-Stennis funds, Cooperatives--are not large compared to National Science Foundation funding in related fields

POSITION STATEMENT OF PARTICIPATING SCIENTISTS ON THE REPORT OF THE SCIENTIFIC ROUNDTABLE

ISSUES OF BIOLOGICAL DIVERSITY IN THE CHEQUAMEGON AND NICOLET NATIONAL FORESTS

A group of 22 scientists met at the direction of the Chief of the United States Forest Service at Rhinelander, Wisconsin on September 20–23, 1992 to discuss how to protect or enhance biological diversity on the two national forests in Wisconsin. These 22 scientists, including the three co-chairs, represented a true multidisciplinary group whose expertise ranged from forest, wildlife, and aquatic ecology, to genetics and palynology. The charge to us was to define the current level of understanding of biodiversity, and given that limited knowledge, provide recommendations that would protect and/or enhance diversity until research futher defines risk and threats to diversity.

Given the political and widely varying scientific interpretations of biodiversity, there was an astonishing degree of consensus among the 22 scientists. As would be expected, however, there remain diverging opinions among the scientists over the exact type and severity of the risks and threats to diversity: "While most scientists at the Roundtable quickly agreed on the general nature and significance of threats to diversity, all admitted that we face considerable uncertainty regarding the full extent to which various elements of diversity are threatened, the scales at which these threats operate and the exact mechanisms through which they operate. Consequently, protection of biodiversity should be approached through an adaptive management process."[4] In other words, the group decided to take a conservative, theoretical approach even though direct evidence of major threats to diversity was lacking.

It was not our charge to analyze, nor does the report address, the adequacy of past and current management practices in protecting and enhancing biodiversity. This report is neither a condemnation nor an approval of past management. Rather, it looks to the future. Certainly, the rapid recovery of the Nicolet and Chequamegon forests from the massive fires and timber exploitation of 100 years ago at least partially demonstrates their resiliency to disturbance. It was the existing good health of the forest that allowed us to make adaptive management recommendations that, we hope, will have minimum impact on current operations. The second rountable focused on the socio-economic impacts of these recommendations.

It is extremely difficult to make specific management recommendations based on the unproven theories that surround biodiversity. For instance, the need for reserves and corridors to mitigate the negative effects of fragmentation on the movement of species and genetic populations within and between ecosystems is certainly scientifically plausible, but has not been demonstrated for northern Wisconsin's forests. It is within this uncertainty that we made our conservative, yet proactive recommendations.

The discussion at the conclusion of the 3-day roundtable revealed a consensus that diversity could be best protected and even enhanced by using proven forest management practices, including harvesting. Even so, the scientists struggled to find balance when so little is known: "* * * while it is relatively straightforward to anticipate how changes in management might successfully ameliorate other threats." Also, "* * * in the presence of scientifically plausible, but unproved, deleterious impacts, debates have emerged over what risks should be accepted while we postpone some options and modify others awaiting more concrete information over which interim decisions are most appropriate."[5]

Because of the uncertainties involved, the recommendations provided in the report are guidelines for how existing practices should be modified or redirected in a manner to ensure protection of diversity while research provides further definition of any serious threats. While the report recommends concrete actions—such as conducting a gap analysis—most recommendations are guidelines and should not be considered absolute mandates to apply on every acre: "* * * in some cases, the recommendations may not be viewed as appropriate or feasible."[6] For instance, the large expanses of even-aged northern hardwoods within the two forests provide opportunity to aggregate stands into larger units when harvested. They also provide excellent opportunities to enhance vertical structure by creating small gaps in the canopy to permit regeneration to occur. This should be done where it makes sense to do so. On the other hand, those recommendations concerning global warming are cautionary in nature and focus on the protocols for monitoring to provide advance warning of problems should global warming occur. This, in spite of the realization stated in the report "that global warming may prove to be less of a threat than was believed only a year ago."[7]

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[4] Crow, Thomas, Alan Haney, and Donald Waller. 1993. "Report on the Scientific Roundtable on Biological Diversity convened by the Chequamegon and Nicolet National Forests." Submitted to Michael Hathaway, Nicolet National Forest, and Jack Troyer, Chequamegon National Forest. July 4, 1993, page 15.

[5] Crow, Thomas, et al. 1992. Report to the United States Forest Service, pp. 20–21.

[6] Ibid, page 54.

Even in the face of uncertainty, we must always look to the future. Although final answers cannot be found in this report, all of us recognized the importance of biological diversity and the report reflects that importance. Final answers must wait on future research to provide clarification of risks and opportunity for maintaining and enhancing diversity. Some questions may never be answered. On these things, we were all in agreement. The notable fact of this report resides not in uncertainties and differences of opinion among the scientists on how indecisive or strident the recommendations should be. Rather, in the face of uncertainties and controversy, the participating scientists took a conservative, yet proactive approach to defining those recommendations and guidelines that would maintain or even enhance diversity while still accommodating those that use and depend upon the two forests. This is truly the hallmark of the roundtable and its report.

Ecosystem Management: A New Approach to Federal Forest Management and Planning

American Forest & Paper Resources Board, November 5, 1993

ECOSYSTEM MANAGEMENT

After more than 15 years of forest planning mandated by the National Forest Management Act of 1976 (NFMA), the level of public conflict surrounding many national forest management issues has increased to the point that reasonable solutions no longer seem possible. Some national forests have yet to complete a formal plan. In response to this challenge, the Forest Service has adopted ecosystem management as its new policy for managing national forest lands. Similarly, the Bureau of Land Management has adopted an ecosystem management approach for its lands. Management planning for BLM is guided by the Federal Land Policy and Management Act of 1976 (FLPMA).

This paper outlines AFPA's recommendations based on our assessment that ecosystem management, properly defined and applied, offers new opportunities to reduce the public conflict that has nearly halted management activities on many Federal lands. In addition, managing ecosystems provides a better way for Federal agencies to manage lands to meet the various public goals and objectives. The forest industry must now work with the Forest Service, the BLM, other agencies and interest groups to design a workable approach to ecosystem management before the critical elements become cast in stone.

DEFINITION

The task group examined a number of definitions of the term "ecosystem management," found none of them entirely acceptable, and developed one of its own. We recommend the following definition as a philosophical basis for the forest industry's work on the ecosystem management issue:

> Ecosystem management is a resource management system designed to maintain or enhance ecosystem health and productivity while producing essential commodities and other values to meet human needs and desires within the limits of socially, biologically, and economically acceptable risk.[8]

In other words, ecosystem management means implementation of a range of forestry practices designed to provide positive benefits to all renewable natural resources and to the people who use them.

KEY PRINCIPLES

The above definition incorporates the following essential principles:

1. Human beings and their activities are an integral part of ecosystems. Ecosystem management must consider the full range of human needs.

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[7] Ibid, page 21.

[8] Planners must recognize that there is risk in doing nothing.

2. Healthy ecosystems are essential to the health and sustainability of human societies and the quality of human life. Human activities (as well as decisions not to act) must maintain or enhance long-term ecosystem health.

3. Forest ecosystems are dynamic, resilient, and subject to a variety of ongoing disturbances. They cannot be preserved in a static condition.

4. Active resource management is an important and often essential component of ecosystem management and the conservation of biodiversity.

5. Ecosystems are adaptable to change. A wide range of biologically sound management options exists. Identifying the best option is both a social and biological issue.

6. It is not possible to predict with complete precision the outcome of management decisions within a given ecosystem. Proper use of adaptive management, including proven silvicultural practices, will help to limit risk.[9] A coordinated program of research and monitoring, which builds on existing knowledge, is necessary to develop sound adaptive management strategies.

IMPLEMENTATION

A national ecosystem management policy for Federal lands must recognize the diversity of ecological, social, and economic conditions within and between various regions of the country. It also must provide flexibility for local forest managers to design on-the-ground management programs appropriate for each region's unique ecological, social, and economic needs. Legislation, regulations, or national policy direction developed to implement ecosystem management should provide broad guiding principles, without tightly defining how these principles will be applied at the local forest level.

In addition, ecosystem management must Include the following elements to ensure effective implementation:

1. Ecosystem management strategies must be technically, economically, politically, and socially sound. Successful implementation will require broad public acceptance and support.

2. Ecosystem management must not mean abandoning the principles of national forest or BLM management established by Congress.[10] The Forest Service and other Federal land management agencies should strive to sustain heathy ecosystems and produce goods, services, and amenities as mandated by NFMA, FLPMA and other guiding statutes.

3. Within the context of these principles, the emphasis of forest planning should shift from defining commodity output targets, land allocations, and management constraints to defining the forest conditions needed to meet ecosystem management goals and objectives, including economic and social needs. The Forest Service must establish these Desired Forest Conditions through the forest planning process, with full public participation. The agency must identify the resulting outputs to assure that predictable and sustainable levels will be achieved.

4. The Desired Forest Condition may vary by region and by national forest. The Forest Service should define the Desired Forest Condition specifically in each forest plan, and generally at the national and regional levels.

The Desired Forest Condition describes a dynamic ecosystem condition, selected for a planning unit, which can be developed and maintained over the long term to:

a. provide a range of seral stages and natural vegetation types and structures across the landscape that will meet the needs of the known species existing within the ecosystem;

b. minimize the risk of occurrence of catastrophic levels of destructive natural agents, including insect epidemics or uncontrolled wild fire;

c. maintain the health and vigor of the forest cover at a level that will allow it the maximum opportunity to repel the effects of natural disasters, recognizing that a certain level of dead/down wood is essential in a healthy forest ecosystem; and

d. ensure the economic health and vigor of local communities, which are, in turn, necessary to sustain the ecosystem.

5. Ecosystem managers should understand the elements of forest structure which existed during pre-European settlement times, to the extent that those condi-

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[9] Adaptive management is a process that: (1) defines management goals; (2) identifies areas of biological and management uncertainty; (3) constructs management models that bracket the range of uncertainty; and (4) experiments to eliminate the worst models and thereby reduce uncertainty. In practice, managers take action based on the best available information, assess the results, and use the resulting information to constantly refine their management decisions.

[10] Principles include: multiple use, sustainability, wilderness preservation, and integrated resource planning and management.

tions have been studied and described in research notes, publications, or other literature. Understanding past changes in forest structure will enable forest managers to better predict opportunities to achieve the selected Desired Forest Condition for a national forest or BLM planning area. However, understanding of pre-European settlement conditions does not imply that restoration of certain conditions should be an objective.

6. On-the-ground management should focus on practices designed to achieve and maintain the Desired Forest Condition. Some of these practices will produce predictable levels of resource outputs. While output targets will not drive the management process, forest managers must be accountable for achieving the desired conditions and resulting predicted outputs.

7. Ecosystem management must be applied across the entire national forest and BLM landscape. It must not be limited to those lands designated as suitable timberlands in the current forest plans, for example. Management activities must maintain, enhance and, where necessary, restore the health and long-term productivity of the entire Federal land ecosystem. Activities must be consistent with the legislative authority for agency lands.

8. Inflexible land allocations and inviolable standards and guidelines are not compatible with the ecosystem management concept. Land managers must have the experience and flexibility to explore all reasonable options and design sit-specific management practices that most efficiently achieve the Desired Forest Conditions. Ecosystem management must not become another layer of standards and guidelines grafted onto the existing forest plans.

9. The agencies must implement ecosystem management through the forest plans in full compliance with applicable laws. New management direction must be developed with full public involvement, as mandated by NEPA, for plan amendment, revision and implementation.

10. Ecosystem managers must recognize the limitations of scientific knowledge, accept reasonable risk, and provide a mechanism for incorporating new information as it becomes available. Adaptive management will be the key to both dealing with risk and maintaining future management options.

11. Ecosystem management enables managers to provide for the needs of all species, without the need for separate plans to protect individual species within the planning area.

12. Ecosystem management, applied on Federal lands, should recognize the positive contributions of and impacts on private land. Private lands that are managed according to the forest management principles adopted by AFPA contribute to sustainable forests. Ecosystem management on Federal lands must not impose Federal ecosystem management guidelines on, or result in the reduction of, private landowner management options.

IMPLICATIONS FOR FOREST PLANNING AND MANAGEMENT

The Forest Service can implement ecosystem management within the framework of existing laws and regulations—indeed, it has already begun. However, a number of legislative, regulatory, and administrative changes would, we believe, make implementation more effective.

PROCESS VS. PROCEDURES

Federal land management planning has been driven largely by very specific procedural requirements. For example, the NFMA regulations (drafted by a committee of scientists) established detailed procedural requirements based on the assumption that following the procedures would lead to reasonable, scientifically based resolution of the issues. Unfortunately, many planning problems are not scientific. In practice, this emphasis on detailed procedures focused the public debate on whether or not the agency had fully complied with the required procedures. This approach created numerous opportunities for legal challenges, but did little to resolve the public debate on issues that are primarily social and political rather than scientific. The heavy emphasis on procedures also led to a cumbersome planning process that took years to complete and produced plans that often were out of date by the time they were finally implemented.

Both society and our level of knowledge about ecosystems are undergoing continuous change. These conditions require flexibility to respond to evolving issues and new information on a timely basis. Therefore, forest planning must be viewed as a fluid, ongoing process rather than a problem to be solved, a set of procedures to be complied with, or a task to be completed every 10 years.

New regulations or policy direction developed to implement ecosystem management should lead to a simplified and flexible planning process. The process should provide improved opportunities for the Forest Service and the public to work together to define concepts, test alternative ecosystem management strategies, monitor the outcome, and make refinements based on the results. Ecosystem management must not become just another set of procedural requirements. Instead, it must provide a process to address the long-term health and productivity of forests across the Federal land landscape.

The following elements of forest planning and management processes could be improved: public participation; agency organization and budgeting; regulatory and legislative framework; and research and monitoring. Each of these is addressed below.

PUBLIC PARTICIPATION

Forest planning has proven ineffective in resolving controversies over national forest management, in spite of efforts through forest planning to include the public in the agency's decisionmaking process. In reality, the process has provided opportunities for the public to identify issues and concerns, comment on proposed actions, apply political pressure, and appeal or litigate unacceptable decisions.

The public must have a greater sense of partnership in making the decisions that will affect their lives, although agency line officers must continue to make the final decisions and be accountable for the results. More effective use of public participation during forest planning is needed to ensure greater public ownership in agency decisions. This is essential if the agency hopes to get beyond endless conflict and public polarization.

Effective implementation of ecosystem management will require greater emphasis on local (bottom up) planning and an active partnership between the agencies and interested citizens. Small citizens' groups, often organized by local citizens, increasingly appear to offer promise for resolving complex issues at the landscape scale. Rather than acting as facilitators, line officers and resource managers must also actively participate in the process. They must not delegate the role to resource or interdisciplinary team staff.

The agencies' Washington and regional offices will continue to play an important role in providing consistent analytical tools and broad guidance on global, national, and regional issues. However, local managers must have maximum flexibility to work with local interest groups to design programs appropriate for the unique ecological, social, and economic needs of each Federal land unit. Enduring solutions must be worked out by the people closest to the land and those most affected by the issues.

AGENCY ORGANIZATION AND BUDGETING

Effective implementation of ecosystem management may require significant changes in both the agency organization and budgeting processes, which currently are organized along functional lines. This system encourages competition rather than cooperation between resource specialists, and will pose a significant barrier to implementation of ecosystem management. Similarly, the Forest Service's four-level structure (i.e., Washington office, regional offices, forests, and Ranger districts) has created a topheavy organization, constantly changing policy direction, escalating costs, reduced productivity, and high frustration levels on the part of field people.

Ecosystem management will require highly competent field managers with intimate knowledge of their local forests and communities. Changes may be needed to ensure the agencies organizational structure and budgeting process will support rather than impede effective decisionmaking at the local level.

LEGISLATIVE AND REGULATORY REFORM

Implementation of a workable ecosystem management process may require modification of certain existing legislative and regulatory requirements. For example, the Forest Service's regulations requiring viable populations of all native vertebrate species within the planning area has focused management on individual species rather than ecosystems. In many cases, this requirement has created almost insurmountable management problems. Conceptually, an ecosystem-based approach to management would provide for the needs of all species and eliminate the need for separate plans for protecting individual species.

Similarly, the current requirement to identify lands suitable for timber management would be irrelevant under an ecosystem management system where lands are not allocated for any single use.[11] Greater emphasis on ecosystem-based goals and objectives rather than resource output targets would also change the process for determining future timber sale levels or other outputs. For example, once the Desired Forest Condition is selected, the vegetation treatments to be used and the predicted resource outputs, based on 'acres treated, would be determined and documented. Forests would monitor the accomplishment of acres treated to achieve the Desired Forest Condition. The agency would be held accountable for meeting these acreage targets and for ensuring predicted outputs are achieved.

A comprehensive review of the pertinent laws and regulations will be completed. Legislative and regulatory changes may be needed to effectively implement ecosystem management. NFPA's recommendations regarding national forest plan implementation, amendment and revision procedures remain relevant and should be adopted to ensure efficient incorporation of ecosystem management principles into amended or revised land management plans.

RESEARCH AND MONITORING

Ecosystem management will require a strong scientific basis for management decisions and strengthened linkages between forest science and management. However, an enhanced scientific framework alone cannot resolve most resource management and allocation conflicts. Federal agencies must place scientific conclusions, assumptions, parameters and ecosystem needs in context with social, economic and political needs.

Additionally, the agencies must ensure that the science used to support management decisions is clearly examined and presented for blind peer review and to the public. Land management planning, project implementation, and special agency initiatives all demand this thorough examination prior to adoption of a particular line of reasoning and assumptions.

Finally, agency procedures must allow agency land managers full flexibility to develop and consider policy options based on sound science. It is appropriate to obtain scientists' comments on options developed by line officers and policymakers. However, scientists must not have the responsibility for making policy-level decisions. In addition, any scientific panels or committees organized to consider specific issues must include the full range of scientific disciplines and management expertise necessary to consider properly the subject under consideration. Such panels or committees must operate in full compliance with the Federal Advisory Committee Act.

The agencies' immediate priorities should be to: (1) design effective monitoring programs, and (2) synthesize existing research information into practical advice that will help field managers understand the potential consequences of their management decisions and implement adaptive management techniques. New research should focus on the priority information needs for effective ecosystem management. All forest ownership sectors should be involved in identifying priority needs for ecosystem management research.

AGENCY TRAINING

To date, agency land management planning has increasingly focused on the use of special land allocations, buffer zones and other management constraints. This approach has effectively downplayed the positive role vegetation management can play in achieving society's ecosystem management objectives and instead focused on mitigating potential negative effects. and use plans have become zoning documents which allow, prescribe, or proscribe certain activities on specific management areas, without sufficient consideration of opportunities to achieve management goals and objectives across the entire Federal land ownership.

This reductionist approach is not consistent with the principles of ecosystem management and could lead to adoption of ecosystem management as nothing more than a system of new standards and guidelines or a series of unrelated, project-level ecosystem management activities.

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[11] NFMA requires the Forest Service to specify guidelines which "require the identification of the suitability of lands for resource management." 16 U.S.C. 1604, Sec. 6(g) (2). It also requires the Secretary to "identify lands within the management area which are not suited for timber production * * * [and] except for salvage sales or sales necessitated to protect other multiple-use values, no timber harvesting shall occur on such lands for a period of 10 years. Lands once identified as unsuitable for timber production shall continue to be treated for reforestation purposes, particularly with regard to the protection of other multiple-use values." 16 U.S.C. Sec. 6(k).

Effective implementation of an ecosystem-based management approach will require a carefully directed program of agency training to ensure broad understanding, acceptance, and application of ecosystem management principles.

PUBLIC EDUCATION

The agencies must undertake efforts to ensure broad public understanding and acceptance of ecosystem management. Improved public understanding should lead to more effective public involvement and, hopefully, earlier resolution of public issues and concerns. In adopting an ecosystem management approach, public education programs must focus on the benefits achieved by management of the entire Federal land base to achieve the Desired Forest Condition for the Federal lands.

CONCLUSION

The decision to embrace ecosystem management was clearly an attempt by the Forest Service and BLM to minimize judicial and administrative actions that create deadlock in the management of the national forests and BLM lands. More importantly, it recognized the need for a better way to plan and carry out management direction on these Federal lands.

To achieve the Desired Forest Condition, forestry practices will be needed in some areas where none would occur under today's "all or nothing" management concepts. More acres will be managed to achieve integrated management objectives and maintain long-term ecosystem health. Such an approach should result in forests that are better able to provide a full range of goods and services demanded by today's society.

An ecosystem management approach will change the nature of the forest management debate and has significant potential to reduce public conflict over the long term. The approach outlined in this paper provides an opportunity for interest groups to work with the Federal land management agencies to design an effective planning process for the national forests and other Federal lands. It should lead to decisions which may be implemented on the ground and provide greater certainty for communities dependent upon the Federal lands for their economic and social well-being.

ECOSYSTEM MANAGEMENT IN THE BLM: FROM CONCEPT TO COMMITMENT

INTRODUCING A NEW VISION

The United States Department of the Interior's Bureau of Land Management (BLM) is committed to safeguarding the ecological sustainability of the public's lands. By implementing management that conserves the diversity and protects the integrity of the land, BLM will ensure that present and future generations continue to derive economic, recreational, social, cultural, and aesthetic benefits from public lands.

INTRODUCTION

The BLM has adopted the principles of ecosystem management to guide its management of the public's lands and resources. The purpose of this paper is to define those principles, explain why the BLM is adopting an ecosystem approach to management, demonstrate how ecosystem management differs from present management, and discuss the opportunities and challenges brought on by the BLM's new management philosophy.

What is Ecosystem Management?

Ecosystem management recognizes that natural systems must be sustained in order to meet the social and economic needs of future generations.

Ecosystem management is the integration of ecological, economic, and social principles to manage biological and physical systems in a manner that safeguards the long-term ecological sustainability, natural diversity, and productivity of the landscape. The primary goal of ecosystem management is to develop management that conserves, restores, and maintains the ecological integrity, productivity and biological diversity of public lands. Among other things, sustainable ecosystems provide habitat for fish and wildlife, clean drinking water for communities, wood fiber, forage, and recreational opportunities.

Why is an Ecosystem Approach to Management of the Public Lands Necessary?

The cumulative effects of past activities on public and private lands have often led to degraded aquatic and riparian systems; less productive rangeland conditions; fragmented plant, animal, and fish habitats; and forest health problems. Human population growth, increased use, fire prevention, flood control, and other factors, also have contributed to degradation of the public lands and caused significant declines in the range and numbers of many native flora and fauna.

Furthermore, the intentional and unintentional introduction of exotic plant, terrestrial, and aquatic species jeopardizes the biological diversity of the public lands. For example, the infestation of exotic, noxious weeds threatens the productivity of the western rangeland and the viability of many native plant communities. About 8 million acres of BLM land are infested by noxious weeds which spread at about 14 percent per year. In other words, 2,000–3,000 acres of productive BLM lands are lost to noxious weeds per day.

Nonetheless, public lands are the last refuges for many vanishing species. For example, over 191 federally listed threatened and endangered plant and animal species and over 1,100 candidate species occur on BLM lands. BLM lands provide habitat for at least 109 salmon and steelhead stocks that are threatened with extinction.

Ecosystem management safeguards ecological integrity and provides economic opportunities.

Communities whose economies depend on public lands are often the most seriously affected by ecological degradation. The declining timber and commercial and recreational fishing industries of the Pacific Northwest, for example, demonstrate the economic repercussions and social displacement that can accompany ecosystem degradation. Conservation efforts on public lands can make a critical difference to the viability of vulnerable plant and animal species and the stability of local economies. Poor forest and rangeland health, degraded riparian areas, and inferior aquatic habitats can threaten species' viability, resource productivity, and ultimately, the overall sustainability of ecological systems.

How is Ecosystem Management Different From Current Management?

Traditionally, resource management strategies in the West have emphasized commodity production and the commercial use of natural resources. Management objectives were often designed to expedite the development, extraction, and/or production of resources on public lands. Other uses and values such as wildlife and fish habitats, some recreational activities, cultural, scenic, and aesthetic resources were often viewed as constraints or mitigation for more intensive uses.

Management strategies that emphasize commodity production tend to separate BLM programs along functional lines. This lack of internal coordination detracts from the Agency's ability to develop coherent and integrated management strategies with other Government agencies, user groups, private landowners, and other interested parties.

Ecosystem management will assist the BLM in coordinating efforts to identify and achieve the desired future condition of public lands at multiple geographic levels. Ecosystems do not have absolute or permanent boundaries. They change and evolve in response to both human influence and natural events. Because ecological systems do not always correspond to existing administrative boundaries, the BLM will encourage partnerships, share management responsibilities, and when appropriate, establish common management goals with other Federal, State, and private land managers, local communities, and other interested parties.

Ecosystem management will not eliminate the necessity for making difficult choices:

The application of ecosystem management principles to public lands will not eliminate the need to make difficult resource allocation decisions. The overriding objective of ecosystem management is to ensure the ecological sustainability of the land. Ecological factors impose explicit limits on land use. The BLM will make management decisions with a better informed understanding of the relationship among land management activities, site-capability, social and economic demands, ecological health and sustainability. Resources will be allocated within the constraints dictated by maintaining long-term ecosystem health. BLM sometimes lacks critical baseline information on the historic and present conditions of the public lands. Obtaining crucial baseline data is a BLM priority that will enable the Agency to make better informed decisions on the public's lands.

BLM is responsible for 300 million acres of subsurface mineral estates. The leasing and operations of these lands should be conducted by the same principles that are applied to BLM surface lands. BLM will participate appropriately in aspects of leasing and operations to ensure that conform to the principles of ecosystem management.

Ecosystem management provides a framework in which scientific information will be used to more objectively evaluate resource trade-off decisions. Successful implementation of ecosystem management principles hinges on the integration of scientific information with resource management and allocation decisions. BLM will ensure that short-term economic and political objectives are integrated with long-term objectives designed to restore and maintain ecosystem integrity, productivity, and diversity. As new information becomes available, management direction will be modified to ensure that BLM lands attain desired future conditions.

ECOSYSTEM MANAGEMENT PRINCIPLES

While there are legal provisions that Congress could change to facilitate ecosystem management, the principles described below are consistent with the mission of the BLM as outlined in the Federal Land Policy and Management Act (FLPMA), which includes the following definition of "multiple use" (43 USC 1702(e)).

> . . . [H]armonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.

BLM management actions will be governed by the principles described below:

- Sustain the productivity and diversity of ecological systems

The BLM will manage the public lands to sustain natural ecological processes and functions in order to provide resilience to short-term stress and adaptation to long-term change. We will conserve, maintain, and restore the ecological integrity of the land and provide for human values, products, and services within the limits of ecological sustainability.

- Use the best available scientific information as the cornerstone for resource allocations and other land management decisions

The BLM will use scientific information (including biological, physical, economic, and social), research, new technologies, and the results of monitoring to determine appropriate local, landscape, and regional management strategies. Closer working relationships between researchers and managers will be encouraged to better understand the effects of management activities on the land. The BLM will work cooperatively with other Federal and State agencies, researchers, local governments, and universities to develop methodologies and technologies to restore impaired ecosystems.

- Involve the public in the planning process and coordinate with other Federal, State, and private land owners

Most resource issues require coordination and cooperation among public and private land managers. The BLM will form partnerships and exchange data with Federal, State, and private land managers, researchers, universities, Native American tribes, and interested publics to resolve multi-jurisdictional resource issues such as anadromous fish conservation and restoration, migratory bird habitat protection, and air and water quality. Input from all interested and affected parties will be sought to develop management strategies that provide for social and economic well-being while safeguarding ecosystem health.

Whenever possible, BLM will integrate management efforts with those of private land holders and assist in conserving and restoring the health and productivity of the land. However, BLM has no management authority on private lands and will work only with interested land holders. BLM will not attempt to dictate private land practices.

- Determine desired future ecosystem conditions based on historic, ecologic, economic, and social considerations

The BLM will coordinate across administrative and political boundaries to assist in determining the desired future condition of ecosystems. In order to safeguard sustainable ecosystems, ecological, economic, political, and social factors will be considered to determine appropriate resource uses, cost of uses, products, and services on the public lands.

- Work to minimize and repair impacts to the land

Land disturbing management activities on the public's lands such as grazing, mining, timber harvest, right of way developments, and some recreation activities will be conducted in a manner that minimizes ecosystem fragmentation and degradation and maintains the ecological health and diversity of the land. All management activities will include rehabilitation provisions that safeguard the long-term diversity and integrity of the land.

- Adopt an interdisciplinary approach to land management

Presently, different programs within the BLM are too often functionally isolated by their own specific areas of interest and expertise. In the future, BLM programs that are currently separate will work together to set priorities and objectives to ensure consistency among different program areas. For example, the BLM's range, wildlife and fisheries, forestry, recreation, and minerals disciplines will establish common objectives and management prescriptions for activities within critically important riparian areas. Program advocacy will yield to the common objective of conserving and restoring sustainable ecosystems.

- Base planning and management on long-term horizons and goals

The BLM will plan, manage, and monitor over the long-term. Sustaining ecosystems requires that sound, long-term ecological objectives are defined before short-term commercial and political objectives are identified. The BLM will develop measurable, and quantifiable resource condition objectives whenever possible. Upward trends and patterns in ecosystem health will be used to define resource objectives. Resource objectives will be met if 1) site-specific and landscape conditions are at a desired condition or 2) patterns of changing conditions are in an upward trend.

Local management actions influence resource conditions well beyond adjacent borders. For this reason, the effect of management actions will be considered at the local, regional, and National levels. The BLM has a unique responsibility to protect public resources that are not provided for by economic markets, such as biological diversity, aesthetic, cultural, and some recreational values.

- Reconnect isolated parts of the landscape

BLM management actions will focus on connecting all parts of the landscape. For example, rivers will be managed in association with floodplains and management activities in upland habitats will be considered for their effects on riparian areas, surface-waters, and ground-waters.

- Practice adaptive management

Monitoring and inventory information will be used to assess the effect of management actions on ecosystem health. The results of monitoring will be integrated into management decisions and management will be adapted as resource conditions warrant. Management prescriptions will be adapted to reflect changing ecosystem conditions; consider the management actions of other Federal, State, and private landowners; balance the effects of management on the condition of the land; and obtain stated objectives. Monitoring programs will be developed that clearly describe baseline resource threshold levels, which, if exceeded, will trigger delay, modification, or cancellation of management activities and/or refinement of management direction.

The BLM will coordinate with other agencies and interested publics to review and apply appropriate monitoring methods and techniques to the public lands. Whenever possible, management, monitoring, and inventory will be coordinated across administrative boundaries and conducted in a manner that effectively demonstrates the health of an ecosystem. Monitoring will ensure that: 1) management direction is implemented, 2) management direction is effective, and 3) management assumptions about ecological conditions and their response to treatments remain valid over time.

MOVING TOWARDS ECOSYSTEM MANAGEMENT: OPPORTUNITIES IN THE BLM

The BLM is participating in a number of efforts that are consistent with many of the principles of ecosystem management. Several of these are described below:

California Bioregions

In California, the BLM signed a Memorandum of Understanding with other Federal, State, and county partners to develop a coordinated, State-wide biodiversity planning strategy. The effort coordinates the actions of the principal land management agencies under the long-term goal of conserving the rich natural heritage of each major bioregion in California while maintaining economic growth and development.

Bring Back the Natives

The BLM, the USDA Forest Service, and the National Fish and Wildlife Foundation are in the third year of a cooperative aquatic species restoration campaign that emphasizes interagency coordination, watershed management, and improved land use practices to conserve and restore aquatic and riparian habitats on Federal lands. In 1994, over 50 projects will focus on restoring native species to 14 States.

Forest Conference Activities

On April 2, 1993, President Clinton convened a Forest Conference in Portland, Oregon. The President directed the Federal land management agencies to provide him with a socially responsive, scientifically sound, ecologically credible, and legally responsible plan that would address old growth forest issues such as the controversy over protecting the northern spotted owl in the Pacific Northwest. A multi-disciplinary, interagency team developed a series of forest management alternatives for the President's review. The team's key objective was to develop management prescriptions that would safeguard the viability of native species and allow for the production of a sustainable level of goods and services. Included in the management direction are provisions that prohibit timber harvest in critically important riparian areas until it is proven that riparian management objectives can be met.

PACFISH (Pacific Salmon and Steelhead Recovery Strategy)

The BLM and the USDA Forest Service merged efforts to develop a common strategy to conserve and restore anadromous salmonid habitats on public lands in March, 1993. The strategy, known as PACFISH, would conserve and restore Pacific salmon and steelhead habitats and associated watersheds on Federal lands in the West including Alaska. PACFISH stresses the integration of sound scientific and research information with on-the-ground management direction. The PACFISH strategy also formed the aquatic and riparian components of the preferred option developed by the Forest Conference.

Neotropical Migratory Birds/Partners in Flight

Partners in Flight (PIF) is a coordinated, international effort designed to conserve neo-tropical migratory bird species and associated habitats. PIF establishes National, regional, State, and physiographic-province working groups that coordinate monitoring, research, and public education efforts on neotropical migratory birds and their habitats. PIF working groups are comprised of Federal and State agencies and private organizations that work together to integrate management efforts for migratory birds.

MOVING TOWARDS ECOSYSTEM MANAGEMENT: CHALLENGES FOR THE BLM

BLM is faced with numerous legislative, political, regulatory, programmatic, and cultural obstacles that may hinder the successful implementation of ecosystem management. Our ability to resolve these and other issues will directly influence the efficacy of ecosystem management.

Management Incentives

Historically, Federal agencies are rewarded for achieving targets based on the production of commodities. Other objectives, especially those that were non-consumptive, such as aesthetic and scenic values and some recreation, were sometimes neglected. Since the production of all goods and services is dependent on ecosystem health, managers' overriding objective should be to maintain naturally diverse and sustainable ecological systems. Federal agencies should develop management incentives that are based on the present state and desired future upward trend of resource conditions (with consideration given to the effects of past activities and natural events on the land, i.e., fire, drought, etc.). Managers will be responsible for resource conditions and trends that contribute to/degrade ecosystem health. The reasons for declining resource trends will be identified and addressed.

Managers will be provided with training opportunities designed to facilitate the implementation of ecosystem management. Interdisciplinary training will be provided to BLM employees with an emphasis on developing both cross-cutting and scarce skills fire ecology, geomorphology, and soils and aquatic ecology.

Administrative Boundaries

Agency attempts to implement an ecosystem approach to management are complicated by the presence of administrative boundaries that typically donot correspond to ecologically based boundaries. Boundaries for the public lands were primarily delineated to accomplish social and political goals. Ecosystems occur at a variety of scales and federal agencies are rarely the sole managers of large, self-contained ecological systems. In addition, State and federal agencies often operate under different legislative mandates.

The agencies' ability to recognize ecologically based boundaries would assist them to define long-term resource condition trends and objectives from a landscape perspective and would greatly enhance the ability of resource managers to predict and assess the effects of management activities on the land. BLM is prepared to enter into agreements and partnerships with private and Federal land managers to coordinate planning, adaptive management, and monitoring.

The Role of other Agencies, Universities, and Researchers

The National Biological Survey (NBS), USDA Forest Service Research Stations, the Environmental Protection Agency (EPA), the Agricultural Research Service (ARS), university research programs, and others could assist land management agencies to integrate administrative boundaries with ecologically based boundaries in order to:

- Identify management units that will facilitate cumulative effects analyses and/or watershed analyses;
- Map the habitats of threatened and endangered species and rare flora and fauna on public lands;
- Identify sustainable commodity production levels within an ecologically based boundary (e.g., timber harvest in a watershed, forage production across a landscape); and
- Implement threatened and endangered species recovery programs.

The researchers would be well-equipped to review and analyze existing and potential landscape analysis techniques (e.g., Geographic Information System technology (GIS), Environmental Monitoring and Assessment Program (EMAP), Landscape Ecology Modelling and Analysis (LEMA), and GAP Analysis) to utilize their full potential as analytical tools to manage the Federal lands.

Resource and Data Classification Systems

Coordination among management agencies is impeded by the fact that Federal land management agencies often employ different data standards and resource classification systems. Standardization in the following areas would promote interagency coordination:

- classification of watersheds, rivers and streams
- classification of standing waters
- classification of wetlands, meadows, and bogs
- classification of soil types and land forms
- classification of vegetation and riparian areas

Land management agencies use different computer systems which further complicates information sharing. The creation of a land management agency computer network and data base should follow the standardization of data elements and data collection processes. The ability of land management agencies to cross-link resource data and other information is vital to managing diverse systems such as watersheds and vegetation types.

QUESTIONS FROM SENATOR CRAIG AND RESPONSES THERETO

David G. Unger

Question 1: What is the relationship of ecosystem management to the laws which guide your overall management—primarily the National Forest Management Act (NFMA)?

Answer: The concept of ecosystem management is not inconsistent with the laws which guide Forest Service management, including NFMA. Many of the concepts of ecosystem management are readily implemented under the existing statute.

Question 2: In managing for ecosystems we are entering a world of uncertainty. Can it be done within the current constraints of NEPA which calls for alternatives, and requires a concise description of impacts for the selected alternatives?

Answer: Ecosystem management can be implemented within the requirements of NEPA. It must be recognized, however, that there will always be uncertainty regarding the impacts of most resource decisions, and that management activities should be continuously adapted to new information as it becomes available.

Question 3: Will NEPA need to be changed?

Answer: The statute and implementing regulations (40 CFR 1500–1508) do not need to be changed, but there are opportunities to consider more effective ways to implement the statute and regulations. Ecosystem management requires adaptation to new information as it becomes available. We are exploring ways to accomplish this more efficiently within NEPA procedural requirements.

Question 4: I have a draft paper from the Soil Conservation Service which is an action plan for "Ecosystem-based Assistance for Management of Natural Resources." What is the relationship of this action plan to Forest Service Policy?

Answer: The Forest Service and SCS, with other USDA agencies, have formed a cooperative ecosystem management working group to strengthen delivery of services through coordination of programs and polices related to ecosystem management. The action plan was well underway when our working group was established and provided a good basis for the present partnership.

Question 5: The SCS plan appears to deviate from the spirit and intent of the Cooperative Forestry Assistance Act, as amended by the Forestry Title of the 1990 Farm Bill which give leadership to State and Private Forestry and to the state foresters to deliver forestry programs to private landowners. Has the Forest Service relinquished this Role?

Answer: The Forest Service has not relinquished its role provided in the Cooperative Forestry Assistance Act, as amended by the Forestry Title of the 1990 Farm Bill. The SCS "draft paper" has been modified to clarify the roles of both the SCS and Forest Service. The SCS has responsibility for programs on private non-industrial, non-forested lands and the Forest Service has responsibilities for programs on non-industrial, forested lands.

Question 6: Has the Forest Service had any input into development of the SCS plan?

Answer: The Forest Service reviewed the "draft paper." There were some inconsistencies in the draft which have since been clarified by the SCS and Forest Service working together in partnership.

Question 7: Because of the uncertainties inherent in ecosystem management, isn't it ripe for entanglements by appeals and lawsuits?

Answer: Ecosystem management issues will undoubtedly become the subject of appeals and lawsuits. Appeals and litigation result whenever various interests view complex natural resource issues from differing perspectives.

Question 8: Will it (ecosystem management) reduce public conflict over management activities?

Answer: Since there is no universally accepted understanding of the role of public lands, there is likely to be a public conflict over management activities. However, Ecosystem Management does offer opportunity for minimizing these conflicts. By being able to better understand the capability and suitability of the land for producing goods and services that can be sustained over time, we can offer more informed choices to the public and decisionmakers. Within that context of capability and suitability, choices can be made that are economically viable, environmentally sound and socially acceptable.

Question 9: What new legislation, or refinements to existing law, are needed to facilitate the development of ecosystem management?

Answer: There are opportunities to modify existing laws to facilitate implementation of ecosystem management. For example, the Federal Advisory Committee Act imposes some limitations on including the public in planning efforts. The National Forest Management Act includes some requirements which may be outdated in an era of ecosystem management. In addition, the interaction of the numerous environmental statutes applicable to National Forest lands, such as NFMA; NEPA; and the Clean Air, Clean Water, and the Endangered Species Acts; poses a complex situation which is probably best addressed holistically rather than individually.

Question 10: Do the strict procedural requirements of NFMA inhibit the use of adaptive techniques needed to accomplish ecosystem management?

Answer: NFMA currently provides for amending forest plans whenever needed in addition to the requirement for periodic revision at least every 15 years. It also requires ongoing monitoring and evaluation. These are the basic processes of adaptive management which is essential to ecosystem management. We are exploring ways to adjust our implementing regulations to allow speedier responses to new information.

Question 11: Will your policy accept that human beings, and their activities, are an integral part of ecosystem?

Answer: Forest Service ecosystem management principles recognize that people are part of and depend on ecosystems, and that human circumstances are shaped by, and in turn, shape ecosystems. Agency planning and management policies and numerous laws recognize that people value and desire a broad spectrum of benefits from ecosystems.

Question 12: If we are to truly manage ecosystems, shouldn't we re-examine and include those lands which have been set aside for no treatment in your current management plans?

To illustrate the problem—on the Clearwater National Forest in Idaho 41% of the land base is designated hands-off either by law or by forest plan allocations.

Answer: Lands which have been designated as unavailable for various activities in forest plans are still part of ecosystems. The role of these lands in providing various ecological functions or in desponding to various social values is considered when resource decisions are made. Land allocations in the forest plan are reassessed at the time of each forest plan revision, and adjustments are made if a change in their allocation is appropriate.

Question 13: How far along are you in acquiring the Geographic Information Systems which will be needed to manage ecosystems?

Answer: We already have GIS capability on a number of forests. To expand this capability to other forests, we are evaluating and testing bids received under project 615 contract. Contract award is tentatively scheduled for the first quarter of calendar year 1994. If there are no protests, equipment delivery should begin around mid-May for the pilot sites. The Project 615 contract extends to calendar year 2002 for purchase of equipment and to 2006 for maintenance.

Question 14: Doesn't the term "below cost timber sales" become obsolete in the context of ecosystem management?

Answer: It depends on the primary objective associated with a timber sale. For example, where the primary objective is to improve wildlife habitat or to curtail the spread of an insect infestation in order to maintain forest health, the question is whether the timer sale is the least-cost means to achieve the objective. Where the primary objective is commodity production, the question of profitability remains even though these projects are conducted in the context of ecosystem management. In fiscal year 1993, the Forest Service made a concerted effort to identify the primary purpose of timber sales. This information will be included in the FY 1993 Timber Sale Program Annual Report due in late February, 1994. We anticipate more refinement of this information as forest plans are revised.

Question 15: Describe the ongoing research in your agency which is intended to aid the development of ecosystem management policy?

Answer: Forest Service Research supports the ecosystem management approach by providing the fundamental knowledge, technology, and scientific assistance required to apply ecological principles to the management of lands and resources. The ecosystem management research program includes studies to:

- Better understand resource management impacts and uses on ecosystem structure, composition, and function;
- Provide information on integrating resource uses and ecological values across a range of spatial and temporal scales;
- Develop knowledge and technologies needed to maintain and enhance biological diversity and ecosystem productivity while maintaining resources for human uses;
- Determine biological, physical, and socio-economic implications of ecosystem management;
- Develop knowledge and technologies to monitor management impacts on ecosystems at multiple spatial and temporal scales; and to
- Synthesize current knowledge of ecosystem structure and function and apply this knowledge to ecosystem management.

Question 16: Can we achieve the interdisciplinary working relationships needed to carry out ecosystem management?

Frankly, I don't think it's working. There is a great deal of internal division along functional lines.

Answer: We can achieve the interdisciplinary working relationships needed to carry out ecosystem management. In fact, we have put together a portfolio of case studies which demonstrate applied ecosystem management. A common thread throughout these cases is the recognition and development of new ways of doing business. Some of these differences include integrating our skills, better customer service, and developing partnerships with other Federal and State agencies and non-governmental organizations. To refine and institutionalize these concepts, we have established a reinvention team to look at how we can reorganize the Forest Service to best implement our mission, vision and guiding principles.

Question 17: How do you envision ecosystem management will address the significant noxious weed problem we have throughout the West?

Answer: An ecosystem management approach is ideally suited to dealing with noxious weeds. Cooperation with others, coordination of goals and a holistic approach are essential to effective noxious weed management. Ecosystems are connected across administrative, ownership, and jurisdictional boundaries—as are weeds. Ecosystem management aims to sustain biological diversity. Invasion of noxious weeds is a significant threat to biological diversity and sustainable ecosystems in many places.

Question 18: Are you coordinating the development of your policy with the BLM?

Answer: Yes, we are coordinating development of policy with BLM. The Forest Service and BLM are jointly developing parallel planning rules which incorporate the principles of ecosystem management. In addition, we participate in an "Interagency Ecosystem Management Coordinating Group" consisting of representatives from about 15 agencies and departments. The purpose of this group is to foster collaboration among agencies to develop a long-range agenda for ecosystem management.

Jim Baca

Question 1. What is the relationship of ecosystem management to the laws which guide your overall management—primarily the Federal Land Policy and Management Act (FLPMA)? Are they compatible as they stand?

Answer. The principles of ecosystem management are fully compatible with BLM's legislative mandates. For example, the Federal Land Policy and Management Act (FLPMA) defines "multiple use" as:

> [H]armonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output (43 USC 1702(e)).

An ecosystem approach to management is entirely consistent to multiple use. The implementation of ecosystem management will enable BLM to more closely follow the multiple use mandate as defined by FLPMA. Traditional site-specific use strategies will be adapted to reflect a more holistic systems-type perspective.

Question 2. In managing for ecosystems we are entering a world of uncertainty. Can it be done within the current constraints of NEPA which calls for alternatives, and requires a concise description of impacts for the selected alternatives? Will NEPA need to be changed?

Answer. Ecosystem management will not diminish the need to formulate management alternatives and to analyze potential environmental consequences, including cumulative impacts, as required by NEPA. In fact, evaluating, predicting, and assessing the effects of management activities on the land takes on added importance in an ecosystem approach to management. Managers will be professionally responsible for resource conditions and trends that contribute to and/or degrade ecosystem health and sustainability.

BLM resource managers will be expected to consider the condition of the land and to estimate the long-term environmental consequences of management activities prior to allocating land uses. Thus, the sort of thorough environmental analysis demanded by NEPA is an essential component of BLM's ecosystem management concept. The requirements of NEPA are sufficiently flexible to accommodate this concept and actually encourage doing so.

NEPA should not need to be changed because of any inherent uncertainties that may exist with regard to ecosystem or other management principles. NEPA is a procedural statute that requires agencies to prepare environmental analyses before embarking on program initiatives or changes, and therefore cannot pose substantive conflicts with management principles, new or old. NEPA regulations provide for addressing uncertainty and require, above all, that uncertainty be identified. Information on reasonably foreseeable significant adverse impacts must be obtained unless the cost is exorbitant, in which case agenciesshould conduct such evaluations "based upon theoretical approaches or research methods generally accepted in the scientific community." (40 CFR 1502.22)

Question 3. How is BLM incorporating ecosystem management into its new resource management plans for O&C lands?

Answer. The principles described in the Forest Ecosystem Management Assessment Team report (FEMAT) will guide BLM's management of the O&C lands within the range of the Northern spotted owl. The FEMAT strategy describes an ecologically credible, socially responsive, scientifically sound, and legally responsible plan that should resolve many of the controversial old growth forest issues in the Pacific Northwest.

Consistent with the principles of ecosystem management, a multi-disciplinary, interagency team developed a series of forest management alternatives based on the best available science. FEMAT management prescriptions are designed to maintain the forms and functions of old growth forest ecosystems in the Pacific Northwest thus safeguarding the viability of native species and allowing for the production of a sustainable level of goods and services to the public.

Question 4. Because of the uncertainties inherent in ecosystem management, isn't it ripe for entanglements by appeals and lawsuits? Will it reduce public conflict over management activities?

Answer. Director Baca believes that implementation of ecosystem management will actually decrease the amount of litigation concerning the public lands. The condition of the land, the many threatened and endangered species of flora and fauna, and the logjam of lawsuits against Federal land management agencies make clear that BLM cannot manage ecological systems in a piecemeal fashion simply to satisfy competing interests. Presently, Federal land management agencies spend vast amounts of money responding to lawsuits, potential lawsuits, appeals, and other disputes. The BLM simply cannot afford to consolidate all of our resources on legal entanglements and dispute resolution proceedings. An ecosystem approach to management will enable the BLM to fulfill our stewardship mandate while de-emphasizing our role as arbiter among the many competing land users.

The overriding objective of ecosystem management is to ensure the ecological sustainability of the land. Ecological factors impose explicit limits on land use. Resources will be allocated within the constraints dictated by maintaining long-term ecosystem health and productivity. Management decisions will be made with a better informed understanding of the relationship between land disturbing activities and ecological sustainability; site- capabilities and ecosystem health; and social, economic, and aesthetic demands.

Implementation of ecosystem management will diminish conflict over management activities in at least three ways. First, the BLM will seek more active public input into the resource planning and allocation processes by involving all interested parties without regard to administrative or geopolitical boundaries. Second, we will emphasize local decisionmaking. Third, we will more fully integrate science-based decisionmaking into the resource allocation process. All resource allocation and land use decisions will be scientifically defensible, aim to maintain long-term productivity and ecological sustainability, and promote innovative management.

Question 5. What new legislation, or refinements to existing law, are needed to facilitate the development of ecosystem management?

Answer. There are several ways that Congress could facilitate the implementation of ecosystem management in the BLM. First, laws such as the Mining Law of 1872 that are fundamentally inconsistent with the principles of ecosystem management should be amended by Congress. In that case, it is neither necessary nor desirable to prohibit mining, but we need to ensure that it is carried out in a responsible manner that is sensitive to other resource values.

Second, the principles of ecosystem management demand that Federal agencies integrate management actions from a landscape or watershed perspective. However, the boundaries of national forests and BLM districts were typically drawn to facilitate the accomplishment of social, political, or economic objectives—not ecological objectives. The agencies have developed coordinating mechanisms to initiate efforts such as aquatic habitat protection and rangeland reform.

Third, the *modus operandi* of the Congressional appropriations process can be a limiting factor to the implementation of ecosystem management. Objectives for market valued products such as timber are sometimes targeted by Congress (e.g., the allowable sales quantity of timber). The resource planning process should not emphasize these economic objectives. When this occurs, other resource management responsibilities are factored in as constraints on the production of commodities. Local BLM managers must be empowered to base resource allocation and use decisions on site specific resource and landscape trends and capabilities. The ability of managers to practice local adaptive management safeguards the ecological integrity of the land yet allows for the long-term production of goods and services from the public lands. Accordingly, decisions will address issues comprehensively, thus providing long-term guidance for on-the ground management and greater certainty to the public.

Question 6. Will your policy accept that human beings, and their activities, are an integral part of ecosystems?

Answer. Yes, absolutely, and to help ensure this result, ecosystem management is being developed with the benefit of continuous opportunity for public participation. Safeguarding the ecological sustainability, diversity, and long-term productivity of the public lands makes "good sense."Public lands provide multiple recreational, economic, social, cultural, and aesthetic opportunities for thousands of citizens—our ecosystem management philosophy ensures they will continue to do so. We cannot hope to sustain the long-term productivity of the public's resources if we cannot maintain the sustainability of the land.

Question 7. If we are to truly manage ecosystems, shouldn't we reexamine and include those lands which have been set aside for no treatment in your current management plans?

Answer. There are scientific, economic, and social reasons for maintaining undeveloped lands in natural or near-natural conditions.

First, it is critical that the BLM maintain a sufficient quantity of land in natural and near-natural condition in order to provide baseline data and information on the effect of management activities on other parts of the land. Strategically located lands in near-natural conditions also help balance ecosystem capacity and enhance sustainability. Second, wilderness and roadless areas, Wild and Scenic rivers, and other undeveloped and pristine areas are an important source of public recreation which are vital to western economies. Third, as the United States grows and continues to urbanize, the remaining wilderness and other pristine areas are a source of comfort and spiritual renewal for many Americans. Ecosystem management will enhance the benefits we derive from these designated lands.

Question 8. How far along are you in acquiring the Geographic Information Systems which will be needed to manage ecosystems?

Answer. The ability of managers to make better informed decisions concerning appropriate land allocation decisions will be greatly aided by GIS technology. The BLM has recently acquired new technology in the form of automation hardware/software and is integrating GIS technology/management in a number of pilot areas in the West. However, we have a long way to go before we can effectively use GIS technology to support ecosystem management on a widespread basis.

In January 1994, the BLM will release a GIS Transition Strategic Plan that will describe a plan to effectively merge Automated Land and Mineral Records System (ALMRS) and resource data to support ecosystem management in the shortest possible timeframe. The strategy will identify ongoing and needed work efforts to: establish common resource data definitions and standards; promote data exchange and sharing agreements; deploy ALMRS/Modernization hardware and GIS software products; provide employees with training opportunities; and ensure management and organizational support for the new technology.

The BLM is committed to utilizing the full potential of existing and potential landscape analysis techniques such as GIS, Environmental Monitoring and Assessment Program (EMAP), Landscape Ecology Modeling and Analysis (LEMA), and GAP Analysis. In fact, in the State of Idaho we are presently utilizing GIS technologies to conduct research and management of raptors and California bighorn sheep.

Question 9. Describe the ongoing research in your agency which is intended to aid the development of ecosystem management policy.

Answer. The BLM has been researching and developing an ecosystem approach to management since 1991. This spring, Director Baca appointed an Ecosystem Management Core Team to assist the BLM to further develop and implement this approach. We are developing an ecosystem management concept paper that defines the principles of ecosystem management, explains why the BLM is adopting it, demonstrates how it differs from present management, and discusses the opportunities and challenges brought on by the BLM's new management philosophy.

It is important that BLM managers and field personnel receive ecosystem management related information and training. We are working with the Phoenix Training Center, State universities, and other agencies to provide interdisciplinary training to BLM employees with an emphasis on developing both cross-cutting and scarce skills such as hydrology, fire ecology, geomorphology, and soils and aquatic ecology.

The BLM is actively participating in efforts to facilitate the coordination and integration of land planning, management, and monitoring among Federal, State, and private land managers. We are key participants in interagency efforts such as Pacific Salmon Recovery Strategy (PACFISH), a plan currently under development, rangeland reform, and the Interagency Ecosystem Management Coordination Group. We will also work closely with the National Biological Survey in promoting ecosystem management policy. At the Washington level we are reviewing our budgeting, planning, and organizational structures to ensure they expedite the implementation of ecosystem management.

Question 10. Can we achieve the interdisciplinary working relationships needed to carry out ecosystem management? Frankly, I don't think it is working. There is a great deal of internal division along functional lines.

Answer. Director Baca agrees that different programs within the BLM have, too often in the past, been functionally isolated by their own specific areas of interest and expertise. Management strategies that emphasize the commodity production and use of individual components of the landscape tend to separate BLM programs along functional lines. This lack of internal coordination detracts from the agency's ability to develop coherent and integrated management strategies with other government agencies, user groups, private landowners, and other interested parties. It is also managerially inefficient and does not allow for the most effective use of budgetary resources. In the future, BLM programs that are currently separate will work together to set priorities and objectives to ensure consistency among different program areas. For example, the BLM's range, wildlife and fisheries, forestry, recreation, and minerals disciplines will establish common objectives and management prescriptions for activities within critically important riparian areas. Program advocacy will yield to the common objective of conserving and restoring ecologically sustainable and productive ecosystems. Such interdisciplinary coordination will also be needed at the agency and interagency levels for ecosystem management to be effective. Ecosystem management will assist the BLM in coordinating efforts to identify and achieve the desired future condition of public lands at multiple geographic levels. Ecosystems do not have absolute or permanent boundaries. They change and evolve in response to both human influence and natural events. Because ecological systems do not always correspond to existing administrative boundaries, the BLM will encourage partnerships, share management responsibilities, and when appropriate, establish common management goals with other Federal, State, and private land managers, local communities, and other interested parties.

Question 11. How do you envision ecosystem management will address the significant noxious weed problem we have throughout the west?

Answer. The infestation of exotic, noxious weeds threatens the productivity of the western rangelands and the viability of many native plant communities. About 8 million acres of BLM land are infested by noxious weeds which spread at about 14 percent per year. In other words, 2,000-3,000 acres of productive BLM lands are lost to noxious weeds per day. Slowing the spread of noxious weeds is indeed one of BLM's most daunting problems. One of the BLM's key ecosystem management principles is work to minimize and repair adverse impacts to the land. All land use activities must be conducted in a manner that minimizes ecosystem fragmentation and degradation and maintains the ecological integrity and natural diversity of the land. To prevent or minimize the spread of noxious weeds, management activities will include preventive measures and rehabilitation provisions.

Question 12. Are you coordinating the development of your policy with the Forest Service?

Answer. Yes. We are working closely with the Forest Service, other Federal land management agencies, non-governmental organizations, and other interested public and private organizations to formulate BLM's ecosystem-approach to management. In addition, PACFISH, if implemented, several Fish and Wildlife 2000 initiatives, and Forest Conference related activities will enable us to field-test our principles in conjunction with other agencies including the Forest-Service.

Question 13. What is your schedule for completing the policy which is now in draft?

Answer. Our ecosystem management concept paper has been completed and a copy is attached. In our view, ecosystem management is not a policy but a management philosophy. As we begin to manage entire biological systems, the BLM will learn more about the processes and functions of ecological systems. We will adapt and devise management that provides resilience to short-term stress and adaptation to long-term change. Management direction will evolve as needed to accomplish our objectives. We realize it is critical that we keep the public informed and involved every step of the way.

Dr. Alan A. Lucier

Question 1. Does even-aged management, including use of clearcutting, have a place in ecosystem management?

Answer. Yes. Even-aged management is often the best way to achieve some economic and ecological objectives. It promotes regeneration and rapid growth of "shade intolerant" species such as pines, oaks, and aspens. Many of these species are valuable for timber, and produce seeds that are important food sources for wildlife. After harvest, even-aged management provides habitat for many animals that use the berries, seeds, and dense vegetation that often develop in the bright sun of clearings.

Clearcutting is often an appropriate harvesting method in an even-aged management system. Clearcutting minimizes logging costs and the number of times equipment must be driven onto a site. It also eliminates the temptation to harvest only the largest and most valuable trees. This common and destructive practice is known as "high grading" or "dysgenic selection." High grading leaves the lowest quality trees to grow and reproduce, and is responsible for the low quality of many hardwood stands in the Eastern United States. We may find that many sites harvested using "new forestry" prescriptions have, in effect, been high graded.

Some people argue clearcutting should be prohibited because it inevitably destroys forests. This argument is false and should be rejected. On the other hand, we know that clearcutting has often been applied in ways that are inappropriate for biological or aesthetic reasons. An ecological perspective in forest management may help prevent misuse of clearcutting and other practices.

Question 2. What will happen if large forest areas are set aside as untouchable under ecosystem management?

Answer. Large forest areas have already been set aside for wilderness and other purposes. By the late 1980s, more than 40 million acres were in wilderness or other protected areas on national forests. This is about 22 percent of the total national forest area.

Additional large set asides under ecosystem management (e.g., Option 9) could have serious economic, social, and ecological consequences. The economic and social consequences of Option 9 are described in the FEMAT report, but the magnitude of impact appears to be greatly understated. The ecological consequences are uncertain, and not necessarily positive. Human impacts on forests and related systems have been extensive, and preclude a return to presettlement conditions. Connections of reserves (no matter how large) with surrounding ecosystems have been permanently altered. We have no scientific basis for presuming that populations of endangered species and other ecological values will be optimized by excluding or mimizing human contact with forests over large areas. In some cases, active management may be desirable or even necessary. For example, there is evidence that thinning and fire protection may be beneficial for spotted owls in some areas.

Question 3. Can you outline the global costs and consequences of substituting other construotion materials for wood in order to satisfy the demand we know will continue to grow?

Answer. Some excellent work relevant to this question has been done by Professor Bruce Lippke at the University of Washington and Professor Jim Bowyer at the University of Minnesota. Their studies suggest that much less fossil fuel is required when buildings are made with wood than with alternative materials. Use of wood may thus conserve nonrenewable resources, and help control atmospheric concentrations of carbon dioxide.

Question 4. What are the social and community implications of ecosystem management?

Answer. If ecosystem management is a disguise for a preservationist agenda, it will contribute to further disruption of rural communities, lower employment in forest-based industries, and higher prices for building products. If ecosystem management resolves conflicts between preservation and sustainable development, it will help revitalize rural communities, increase employment in forest-based industries, and stabilize prices of building products.

Question 5. What actions are needed to foster the cooperative research effort you recommend?

Answer. The most important action would be to establish coherent objectives and policies for Federal lands. It is difficult to conduct cooperative research in support of objectives and policies that are being decided on an ad hoc basis through litigation.

It would also be helpful to establish a mechanism for annual regional reviews of forestry research priorities, funding, and opportunities. The reviews might be organized by the USFS Forest and Range Experiment Stations. Participation should be open to all interested parties. Identification of *specific* opportunities for cooperative research should be an explicit objective.

Funding for forestry research through the McIntire-Stennis program should be increased. Consideration should be given to allocating some of the funds through competitive processes managed by regional committees of the National Association of Professional Forestry Schools and Colleges. Priority should be given to cooperative projects that address priorities identified in the regional reviews discussed in the previous paragraph.

Dr. Frederick J. Swanson

Question 1. You've said that timber salvage eliminates important habitat. You're not advocating, are you, that there should be no salvage after wildfire or other catastrophes?

Answer. There are circumstances in which, I believe, salvage logging is appropriate to meet economic and/or biological objectives.

Question 2. If structural diversity in timber stands is the key, can timber management practices be designed to create the necessary structural diversity?

Answer. The key to dealing with diversity issues depends on the issue. If we are dealing with a wide-ranging species, it is necessary to consider management actions at the scales of forest stand landscape (multiple stands), and regional (or the scale of the species' range). Forest stand management can create structural diversity that contributes to meeting specific management objectives, e.g., to provide habitat for specific species. Whether or not this meets the "necessary" standard in the question depends on the mlagement objectives. Uncertainty arises with regard to long-term effects on individual species and especially when whole ecosystems, such as old-growth forest, are at issue.

Question 3. Is diversity no good if it is not created naturally?

Answer. Actively managed ecosystems have critical roles in maintaining and recovering the Nation's biological diversity. Some ecosystems have been so substantially altered for so long that we have little record of their natural states. In other cases societial demand for natural resources leads to management that shifts the relative abundance of components of biological diversity. In both of these examples managed diversity seems consistent with societal expectations.

Question 4. Wouldn't you agree that thinning of young, overstocked timber stands is one valuable tool to increase diversity?

Answer. Thinning of heavily stocked forest stands can be a valuable tool in increasing biological diversity and forest health. Decisions to thin should be placed in the contexts of long-term ecological and geographic (i.e., the nature of adjacent stands) considerations.

Question 5. How do we measure biological diversity? How do we know how much is needed?

Answer. There are many approaches to measurement of biological diversity described in the scientific literature, including measures of genetic diversity within a species, diversity of species, and diversity of ecosystem types. These approaches concern both what components of diversity are present and what are their relative abundances.

The critical second part of your question has both biological and social values aspects. Science can help interpret and predict the ecological consequences of eliminating components of diversity—consequences such as reduction of long-term productivity of soils in response to elimination of a nitrogen-fixing plant species or change in animal community structure in response to removal/reintroduction/introduction of a top predator. This tye of information helps set sideboards for debate on the larger, more difficult questions involved in "how much is needed?"—questions in the realm of social values debated in the context of processes such as legislation and litigation. By this I mean that citizens may determine what they think is needed based on ethical or aesthetic grounds that have little to do with biology or diversity in the scientific sense.

Dr. Donald M. Waller

Question 1. I don't think there is any question that the plentiful aspen and birch stands of the Lake States regenerated from wildfire even before modern man's intervention. Since we cannot use large scale fire due to the air pollution impacts, wouldn't timber harvesting be an efficient alternative to manage ecosystems in the Lakes states forests?

Answer. Timber harvesting does favor early successional species like aspen and paper birch and so has served to greatly increase the abundance of these tree species, even in the absence of fire. It is less clear that this represents sustainable forestry. Recent research suggests that repeated intensive harvesting of aspen results in increasingly destructive infections by the *Armillaria* root rot fungus that eventually kill the trees.[12] The question also implicitly assumes that perpetuating abundant populations of these pervasive and weedy species should be a primary goal for forest management. Most forest ecologists would disagree. Aspen has already expanded drastically in abundance in northern Wisconsin and Minnesota, increasing from less than 3 percent of the landscape of the Chequamegon National Forest before European settlement to more than 28 percent today (Chequamegon National Forest Long-Range Management Plan 1986). Aspen dominates private industrial lands and northern Minnesota to an even greater degree where it has displaced other vegetation types that were once much commoner, in particular old growth hemlock-hardwood stands which have declined from about 60 percent of northern Wisconsin to less than 1 percent.

Thus, the question should not be between fire and logging as a means to perpetuate aspen, an already vastly overabundant forest type, but whether the public interest is really being served by preventing the successional recovery of these forests to some semblance of their original stature and regional diversity. Here, the national forests have a particular responsibility, in that private industrial forestland owners are not likely to modify their management to provide for other important forest types and ages. Timber harvesting is not likely to promote the recovery or development of the forest types most in need of conservation in the region.

Question 2. I understand the endangered grey wolf population is recovering in Minnesota and Wisconsin because aspen regenerated by clearcuts has provided the food base for its prey. Isn't it appropriate for man to intervene to maintain this ecosystem in the proper balance?

Answer. You have been misinformed on the recovery of grey wolf populations in Minnesota and Wisconsin. Many scientific studies indicate that wolf recovery depends on minimizing open road density as many wolves die from accidents with vehicles or by being shot by hunters with motorized access.[13] While some wishful thinkers among the timber industry like to suggest that wolves may be limited by deer densities, David Mech, perhaps the region's foremost deer biologist, has asserted plainly that there is no evidence to support the idea that wolf populations are limited by their access to deer prey. Indeed, this would be difficult to conceive in Wisconsin where the State's approximately 35 wolves face a population of about 1.1 million deer. While one could argue that this situation is far from balanced, promoting clear-cuts and yet more aspen significantly worsens the situation rather than benefiting the wolf or regional diversity because: (1) timber harvest activities require a high road density that threatens wolves, and (2) more aspen boosts deer populations in a landscape already suffering the ill effects of too many deer.

Our current plague of deer represents a substantial public nuisance for many reasons, including: (1) more than 32,000 drivers hit deer last year in Wisconsin, causing millions of dollars in property damage, loss of wildlife, and human injuries and deaths; (2) abundant deer contribute to high densities of deer ticks that are spreading an epidemic of Lyme disease in many parts of Wisconsin and the eastern U.S.; (3) high deer densities preclude the presence of other ungulate species such as Moose, Caribou, and Elk because they harbor a resevoir of a parasitic brain worm that is lethal to these species; (4) foraging by hungry deer directly eliminates populations of orchids, other wildflowers, and many tree seedlings. Deer densities now are estimated to be 2–10 times higher than they were before European settlement, representing a system far out of balance and a browsing threat to the re-generation of several key forest tree species like eastern hemlock and northern white cedar.[14]

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[12] Stanosz, G.R. and R.F. Patton 1987. Armillaria root rot in aspen stands after repeated short rotations. *Can. J. For. Res.* 17:1001–1005.

[13] Thiel, R.P. 1985. Relationship between road densities and wolf habitat suitability in Wisconsin. *Amer. Midl. Nat.* 11: 404–407.

Dr. Chadwick D. Oliver

Question 1. What role did native Americans play in manipulating forest and rangeland vegetation with fire?

Answer. The role of native Americans was varied (and our knowledge incomplete); but generally, they used fire in three ways: they used it to herd wild animals (and maintain browsing conditions); they used it to clear lands for agriculture (more extensively in central America and probably in the Southeastern United States); and they were somewhat neglectful and let fires escape and burn.

The effect of their fire behavior varied with vegetation type and climate.

In places, they created frequent, low, creeping fires which burned small trees and vegetation. These fires led to relatively open, park-like forests with widely spaced large trees, open understories, and much forest floor vegetation. Such forests were found in southern New England, longleaf (and other) pine forests of the Southeastern United States, some ponderosa and lodgepole pine forests of the inland West, and some Douglas-fir forests of the Pacific Northwest.

In places where they did not burn frequently, longer fire cycles occurred (either human-caused or natural). These fires were often more intense, and they more completely (and destructively) burned dense forests. Such fires occurred in some parts (probably less accessible areas) in all parts of North America.

Question 2. Would you please describe the impacts of fire suppression policies on vegetation patterns over the past 80 years?

Answer. The uniform fire suppression policies have had a variety of impacts—beneficial in some places, not in others:

- The initial impact around logging operations was to prevent frequent, repeated burns of harvested areas. Prevention of fires here allowed forests to regenerate and grow, many of which have since been reharvested and regenerated. Without this fire suppression, fire-tolerant brush and herbaceous vegetation would have excluded the trees, resulting in less forest area.
- Fire suppression also gave public and private landowners enough security to feel replanting forests was a safe investment.
- In areas of broadleaf forests (e.g., parts of the Eastern United States), fire suppression prevented low, ground fires from creating hollow trees—and so allowed trees containing merchantable timber to grow and be harvested, but reduced the number of hollow trees for certain animal habitats.
- In many areas, fire suppression gradually changed the tree species in the forest to less fire-resistant species (e.g., reduced Ponderosa pine forests in the Western United States and longleaf pine in the Southeastern United States and oak woodlands and prairie edges in the Central United States).
- In some areas, fire suppression after large windstorms changed the tree species of the post-windstorm forest from what would have regrown without the fire suppression. For example, such suppressions occurred after the 1938 hurricane (New England), Hurricane Hugo (1989, South Carolina), and the '21 Blow (1921) and Columbus Day Storm (1962) in western Washington State.
- In many areas, suppression of low, ground fires has allowed the forests to grow thicker (trees closer together) than they generally did previously, causing them to become weak and currently very susceptible to intense, destructive fires—more intense than usually occurred in these places.
- In many other parts of the inland West where low, ground fires did not occur, the forests have regrown after intense fires of about 100 years ago (e.g., 1910 fires

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[14] Alverson, W.S., D.M. Waller, and S.L. Solheim 1988. Forests too deer: Edge effects in northern Wisconsin. *Cons. Biol.* 2(4): 348–358.

in Idaho and Montana; 1890's and 1920's fires in Okanogan and Colville, Washington; 1880's fires in Sawtooth area, Idaho). These areas are now susceptible to large, destructive fires; fire suppression is simply postponing the inevitable wildfires—unless active measures are taken (See **Question 3**).

- In some places the thicker forest growth because of the exclusion of fires may have lowered the groundwater table and dried wells (e.g., Black Hills of South Dakota).
- In places, the suppression of fires has kept certain stand structures from developing and so reduced habitat and threatened or extirpated species. For example, fire exclusion in the Great Lakes area reduced the amount of young, dense jack pine stands required by the Kirtland's warbler and so nearly made this species extinct. The many "forest opening" species which have become extirpated or extinct in New England are probably because of fire exclusion. The reduction in lynx population in eastern Washington is probably because the lack of fires has reduced the area of openings.

Question 3. What role can you foresee for forestry and silviculture as a replacement for fire disturbances?

Answer. Relative to fire disturbances, forestry and silviculture can have three roles:

i. They can mimic fire disturbances so that disturbances occur (within limits) at a time, aerial extent, and intensity compatible with humans. Fires remove wood from an area by converting wood to atmospheric carbon dioxide through burning. Through this, they also kill trees (and other vegetation and animals) and alter the habitat. Depending on the circumstances, various harvesting practices can mimic various fires by killing and removing some or all trees, thus reducing the potential for wildfires, reducing the carbon dioxide put in the atmosphere, and providing wood products which are environmentally sound substitutes for steel, aluminum, brick, concrete, or wood harvested from places with fewer environmental safeguards.

Other silvicultural operations can also mimic parts of fires. These operations include controlled fires, artificial weed control, etc.

Historically, silvicultural and harvesting operations have intentionally not left burned snags and downed logs; if these are important for ecosystem values, they can be created during such operations.

ii. They can protect forests from (and so control the size of) natural fire disturbances. Natural fires (and the impending ones because of the presently flammable forests) can cover hundreds of thousands of acres—especially where there is a single stand structure (e.g., "stem exclusion" or "old growth"; Figure 2 of written statement) over a large area. Silvicultural activities such as thinning or harvesting can create areas with different stand structures and tree species, thus keeping natural fires from becoming large and so destroying a large amount of forest, habitat, and property.

iii. It can help an area recover from natural fires. Natural fires create large areas with imbalances of stand structures (e.g., Figure 2, written statement) and so shortages of critical habitat. They also result in erosion, flooding, and siltation of streams (e.g., the Los Angeles fires of 1993). Silvicultural operations such as planting trees and other vegetation and removing excess dead trees (which may allow reburning during subsequent years) can help reduce erosion and recover a balance of habitats (stand structures) in the area.

Question 4. How does the manager know what is the right balance of species and habitats in terms of percent of the landscape? Are there rules which apply?

Answer. The manager does not have a precise definition of the exactly "right" balance of species and habitats, just as a medical doctor does not have a precise measure of a "healthy" person. Just as a medical doctor strives to reduce the extremes of "unbalanced" conditions in a human, the manager can try to reduce extreme excesses or shortages of structures, species, and habitats within an area.

For most areas, local forester managers have an idea of the historical range of variability of species population sizes, stand structures, and processes occurring in each area. Using this as a first approximation of a target range, these managers can begin managing the landscape to put it within this range while more is learned (See **Questions 5 and 12**). In areas where violent fires of hundreds of thousands of acres are within this historic range, the manager may choose a narrower range—especially if such disturbances threaten the presence of other natural species, habitats, and processes and other human values.

It is important to recognize several things:

i. The proportion of each species and habitat fluctuated quite widely across the landscape with natural disturbances, regrowth, species migrations, and species changes. The right balance is probably not a single value, but a range which managers should try to stay within.

ii. Species which have not become extinct over the last tens of thousands of years are adapted to this variation; therefore, precise measures of a "correct balance" are not necessary to begin moving away from extreme imbalances.

iii. Waiting until more perfect knowledge is obtained before any management is done will be counterproductive, since such waiting will allow forests to develop even more imbalances.

iv. Simple rules for what is the "right balance" directed from central planning will be counterproductive. Historically, top-down forestry directives of no fires or even-age management have created problems in some areas while they solved problems in other areas. Just as a medical doctor has no simple rules when treating a patient, each local forester manager will have to rely on his/her expertise as well as seek advice and input—but be accountable for the decisions made.

v. This bottom-up, site-specific management approach has been described as a "flexible systems" approach by Dr. Robert Reich (presently Secretary of Labor) in his book "The Next American Frontier."

Question 5. Maintaining a balance of stand structures across the landscape seems important, but how is that balance to be managed and controlled?

Answer. Foresters presently have much knowledge and highly refined, statistically sophisticated computer models which allow them to project changes in stand structures for many decades in the future—with and without various silvicultural manipulations—for nearly all forest areas in the United States. Foresters can similarly project where forests will be susceptible to destruction by fires, insects, and winds.

The knowledge also exists to allow forest managers to project changes in balances of stand structures across whole landscape units with and without various silvicultural manipulations to each subarea (stand). This knowledge is rapidly being put into computer models which will make them "user friendly" within 1 to 3 years.

Using this ability to predict changes in stand structures across landscapes with and without silvicultural manipulations, each local forest manager can determine appropriate silvicultural manipulations for each stand at each time to maintain a desired balance across the landscape. Of course, coordination among local managers will be needed by upper-level managers.

The next step is to implement the operations. The operations will include thinning, uneven-age harvesting, even-age harvesting, planting, controlled burning, and others, depending on local conditions. Many of these operations are known; however, new operations (such as creating snags) may need to be developed.

The planned sequence of operations will be constantly refined with time as more is learned about the target balance or about better operations or as unexpected disturbances interrupt the balance. Monitoring and adaptive management will help.

Question 6. You have stated that "maintaining stable populations of all species by managing for each species individually is an impossible task." Since that is what the Endangered Species Act requires, how would you fix it?

Answer. There are very many species, each of which has certain requirements for its survival. Trying to identify each species, to determine the specific requirements for each species, and then to develop a management scheme which will maintain these requirements is a complex and time-consuming task. In the course of trying to meet the requirements of one species, the habitat of another species with conflicting stand structure (habitat) requirements may be reduced to the point that this species, too, becomes endangered. Then trying to meet the requirements of just these two species will reduce the habitat for a third species until it becomes endangered and demanding attention. Essentially, we would be constantly creating and "chasing" endangered species.

As an example, trying to meet the habitat requirements of spotted owl by setting aside large areas for old growth will reduce the stand initiation habitat for species requiring this structure (See Figure 2 of written comments). This action to save the spotted owl may actually cause such species at the orange-crown warbler, the blue-headed grosbeak, the black-headed grosbeak, the yellow warbler, and others to become endangered; and further actions will be needed to save these species, which may in turn threaten still other species. The result will be a constant process of chasing endangered species which our management has threatened.

An alternative is:

i. Have the proactive provision of maintaining minimal amounts of all structures found naturally within a landscape area. (Viable populations of all species would be the key to such adequate amounts of all structures.) The minimal amounts would be required to fluctuate if such conditions were necessary; these amounts and their fluctuations would be addressed according to **Question 4**, above.

ii. As a backup, address species which become endangered with proactive, intensive, multifaceted efforts toward this species which do not reduce the habitats of other species to unsustainably low values. The multifaceted efforts would include improving *quality* (not just quantity) of habitat, controlling predators and competitors, trying to reintroduce the species to other areas where it may have become extirpated, and resolving other bottlenecks to its population.

For example, rather than try to increase the area of spotted owl habitat, multifaceted attempts to increase the quality of habitat and to control populations of predators (e.g., the native great horned owl) and competitors (e.g., the barred owl, which recently migrated from the Eastern United States) of spotted owls would increase spotted owl populations without threatening other species' habitats.

I am unsure if these changes would require amending the Endangered Species Act or could be accomplished by a combination of adding policies to Federal agencies, incentives for private landowners, and funding to support proactive management if a species becomes endangered. (See **Question 11.**)

Question 7. If one objective in ecosystem management is to maintain a relative balance of all species, does that mean that some species will fall by the wayside?

Answer. Under *any* natural or managed arrangement (including the present one), it is never certain that a species will not fall by the wayside. Under the present arrangement of species-by-species listing, it is likely that a species will fall by the wayside before it is even identified as endangered since all stand structures (habitats) are not maintained across a landscape. In addition, we do not become concerned with species until they become endangered. In essence, we are simply creating and chasing newly endangered species.

By maintaining all habitats and species across broad areas, it is less likely that a species will be confined to a small area and become threatened.

If a species does become threatened, very proactive steps (described in **Question 6**) could be taken to maintain the species, without threatening other species. If there does appear to be a condition where one species will only survive by threatening another species (or allowing another to fall by the wayside), the "God Squad" of the present Endangered Species Act could then decide the fate of these species.

Question 8. If old growth is an objective, will ecosystem management help us get there?

Answer. Constant change ecosystem management (described in written statement) will help us attain old growth as a necessary component of the landscape, for several reasons:

- Since constant change ecosystem management would require maintaining all structures across the landscape (or creating their structural features to the extent possible where they do not exist), old growth would be maintained.
- By having other structures also within the landscape, the existing old growth would be maintained (and replaced as necessary) better than if large areas were managed for just the old growth structure, since the varied structures would not be as susceptible to large, natural disturbances.

Constant change ecosystem management would not maintain large areas in old growth to the exclusion of other structures (and the threatening of other species) and at the risk of old growth species where the large old growth areas may be destroyed by catastrophic disturbances. In fact, maintaining such large areas of old growth may become in violation of the Endangered Species Act if/when a species which requires another structure is found threatened by extinction.

Question 9. You've written that constant change ecosystem management would provide more employment than even a commodity-based approach. Apparently you envision it as more labor intensive. Please explain?

Answer. Commodity-based management generally utilizes relatively few silvicultural techniques in each forest area to produce a product which maximizes economic return to the landowner. Even-age management with little or no commercial thinning are typical of productive soils, and uneven-age management is typical of nonproductive soils. These practices do not necessarily maximize wood volume or quality or maintain all structures across the landscape.

Constant change ecosystem management would entail more, diverse silvicultural activities such as thinning, pruning, creating snags, and others. It would require some uneven-age management on productive soils and some even-age management on nonproductive soils to maintain all structures across the landscape. The result would be more wood and greater wood quality in the long run, both of which would allow more employment through secondary manufacture of high quality products (in addition to more employment in silvicultural operations). More structures in the landscape would also allow more values such as recreation, mushroom picking, etc. This ecosystem management would be more labor intensive; however, most of the extra employment would be paid for by the free market by production of goods and services—not by taxes. (This will be explained in detail in **Question 10**.)

The natural reserves approach to ecosystem management would provide high employment for restoration and for fighting and recovering from large natural fires; however, this employment would be paid for by taxes.

Question 10. Will your version of ecosystem management also be more costly to apply?

Answer. My version of ecosystem management will probably be slightly more costly to the public (taxes) than commodity management but much less costly than natural reserves management; however, my version of ecosystem management may be less costly than commodity production when all costs and incomes from all sources are considered, as shall be explained.

My version of ecosystem management would entail more silvicultural activities and more labor (and so more costs) than commodity management. The land will produce more, higher quality products, more employment, and ecosystem values in the long run. The landowner (public or private) would receive more income from the products, but would have to expend more labor and silviculture costs. Where the extra costs exceed the extra income, there is a cost to the landowner for ecosystem management. (This cost takes such forms as below-cost timber sales on public lands and disincentives for management on private lands.) Other public (taxpayer) costs are reduced, however; for example, unemployment, fire fighting, and concerns with endangered species.

If the total reduction in public costs and the value received by the landowner from producing commodities are both subtracted from the costs of my version of ecosystem management, the net cost to the public (taxes) of ecosystem management will not be very great. (Lippke, B., and C.D. Oliver. 1993. article in "Journal of Forestry," December 1993).

On the other hand, if natural reserves ecosystem management is practiced, the total costs to the taxpayer of employment for any restoration or fire fighting or the cost of unemployment where no one is employed (opportunity foregone) will be much higher.

Question 11. I would like to hear more about the various incentives you propose which will help gain acceptance for ecosystem management.

Answer. As described in **Question 10**, private landowners incur a cost (or reduced profit) it they provide the public values of balanced ecosystems and employment rather than maximum commodity values. Whereas landowners recognize an obligation to some ecosystem values, large costs (or reduced profits) caused by providing large amounts of these values will increase the cost of wood from this region and not allow it to compete with environmentally less favorable wood substitutes—or with wood harvested from areas with fewer ecosystem safeguards.

Incentives can be used to reward the landowner for the extra cost of providing ecosystem values in conjunction with commodities which have traditionally provided profit to the landowner. For example, if there were a reward to having the threatened spotted owl occupy a landowner's forest instead of a penalty, many landowners would actively try to create the habitat rather than harvest stands when young to avoid the habitat. (Alternatively, Montana ranchers are rewarded for having wolves on their land—an incentive which is not counterproductive.)

These incentives can include:

A. A risk-reducing program of bonding stands. This bond would compensate landowners at a fair market value if they were unable to harvest their stands because an endangered species occupied them. This bonding would increase habitat for endangered species and probably reduce their risk of extinction by keeping private landowners from harvesting their stands prematurely to avoid creating habitat for endangered species. It would only cost the government if a private landowner's stand was critical to saving the species.

B. A program of trading or otherwise coordinating stand structure conditions among ownerships within a landscape management area. Presently, antitrust laws prohibit coordination among landowners which would significantly affect the flow of timber. Coordination of stand structures among landowners within a landscape area is important to keep a balance of habitats for species. It may be possible to coordinate among landowners through a system of trading stand structures (or providing structures on a competitive basis, discussed in C). Each landowner could be required to maintain certain proportions of each structure and/or species population on his/her land, but with the ability to trade(buy/sell) their quotas of structure and numbers of animals with other landowners within a landscape unit. This system is similar to the "tradeable pollution quotas" of the 1990 Clean Air Act. Such systems will be less subject to antitrust violations if state laws mandate them.

C. A program of providing structures on a competitive basis among landowners, funded by a public (or environmental organization's) "biodiversity trust fund. Where a needed structure (e.g., old growth, Figure 2 of written statement) is in short supply, the biodiversity trust fund could offer to rent the structure from the landowner who could provide it at the lowest cost. For example, if the public is willing to pay for 2,000 acres of old growth structure to last for 20 years from whichever landowners in the watershed would produce it most cheaply, competitive bidding on contracts to produce old growth (up to 2,000 acres) would provide the lowest cost to producing it. Each landowner would consider his/her forest inventory, cash flow needs, profits and/or losses from selectively cutting the stands and creating snags to produce old growth, and possible returns at the end of 20 years to decide the additional money they would need to make it profitable for them to provide the old growth. This additional money would be their bid price; and the lowest bids would receive the contracts—until 2,000 acres was provided.

Since the general public is largely the beneficiary of these needed habitats, the public could pay for these benefits through the general fund, timber excise taxes, capital gains taxes, public bonds, and carbon sequestration taxes (See Lippke and Oliver, "Journal of Forestry," December 1993). The benefit of competitive markets is that the landowners who provide the stand structures will be those who can provide the benefit at the lowest cost. The cost to produce the objective will be much lower than the value of the structure since the public pays only the incremental cost of producing the structure; and the market value of the timber removed (e.g., at the end of 20 years) continues to pay for most of the management. (In 20 years, another competitive bid to produce old growth can be invited if conditions warrant.)

The size of the trust fund will directly determine how much biodiversity the public is willing to pay for. The competitive bids will ensure the public will receive the biodiversity at most efficient costs.

D. A streamlined set of tax, labor, and environmental laws to encourage investments in long rotations, thinning, and other activities which increase biodiversity. Examples of laws which presently are counterproductive to ecosystem management (my definition) are listed in my written statement.

E. Small (and large) business capitalization incentives, research, and development to create well-developed markets, secondary manufacturing, and other forest product technology components so landowners will be encouraged by high profits from timber and other forest products to invest in the many needed silvicultural operations.

F. A skilled, professional labor and management force capable to prescribing and doing the various silvicultural operations needed to provide the stand structures cheaply and efficiently.

G. A program of buying and selling timber futures so small landowners could receive cash from their immature stands without having to harvest them prematurely. Many private landowners harvest stands when they need the cash, not when the stands return most money (or provide suitable habitats). Allowing a landowner to borrow money from an immature stand (or sell timber futures) would make investments in forestry more liquidable. It would cost the Government primarily to get such a program initiated.

H. A program of providing cash flow incentives to small landowners for such operations as pruning and thinning, similar to FIP and REAP funds previously available for other silvicultural treatments.

Question 12. What is the most important research we should be doing now to aid the development of ecosystem management policies?

Answer. The most important effort would be to reorganize research to make it an active, integral part of management as is found in very active growth areas of the United Stateseconomy—medicine, aerospace, telecommunications, and computers.

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The present segregation of research and management in much of forestry and ecology has been an interesting marriage of convenience—whereby the manager can either continue with a present policy or stop all management while the researcher learns enough to proceed or change course.

By integrating management and research, the managers would be proceeding at each step with the latest scientific knowledge; and the scientists would have both an immediate test of their findings and an immediate input of research needs.

Such integration would occur best in a bottom-up, decentralized management approach and would result in managers demanding research in several areas:

I. Natural ecosystem patterns and processes;
   - the relation of species to all stand structures (including both old growth and other stand structures);
   - historical ranges of structures, processes, and population sizes—and their impacts;
   - other requirements of species (competitors, predators, prey, etc.);
   - riparian and aquatic species requirements;

II. Silvicultural and forest management operations:
   - silvicultural operational techniques and equipment;
   - the impacts of techniques on stand development, soils, snag creation, etc;
   - computerized information systems for coordinating management across landscape areas;

III. Organization and management systems:
   - flexible systems of bottoms-up and top-down management coordination;
   - adaptive management systems;
   - economic and social considerations leading to policies for management;
   - policies and incentives on public lands for accomplishing ecosystem management.

IV. Forest product research (including wood products, recreation, wildlife enjoyment, mushroom production, etc.) to increase the value (and reduce cost) of ecosystem management.

LETTER FROM THE BUREAU OF LAND MANAGEMENT

United States Department of the Interior
Bureau of Land Management
Washington, DC, December 14, 1993

Dear Colleagues: Secretary of the Interior Bruce Babbitt has spoken of the need to develop a "new American land ethic" that is both ecologically responsible and socially responsive. The Bureau of Land Management (BLM), with stewardship responsibilities for over 270 million acres of public lands and 300 million acres of subsurface mineral estates, can play a substantial role in developing and implementing such a new land ethnic.

The land management principles contained within this document, *Ecosystem Management in the BLM: From Concept to Commitment*, provide a new management philosophy and a fundamental change in management of the public lands and their resources. As director of the BLM, I intend to make certain that the principles of ecosystem management frame administration of the public lands. Time has come for us to work with nature for the long-term benefit of society.

The public's expectations and use of Federal lands grow daily. It is the challenge of the BLM to implement management that meets these expectations within the limits imposed by ecological systems and the need to conserve biological diversity and safeguard ecological sustainability.

The BLM is not alone in our efforts to develop and implement an ecological approach to management of the Federal lands. We are working closely with other State and Federal land management agencies, Congress, user and public interest groups, and private citizens to further develop, refine, and implement the BLM's ecosystem management strategy.

Please send me your thoughts on the principles described in this document. I welcome your input on how to best develop and implement ecosystem management. The implementation of ecosystem management is not a static process. It is imperative that our publics are kept informed and involved every step of the way. I hope you will join us in our efforts to restore and maintain healthy and productive public lands.

Sincerely,

(Signed) JIM BACA,
Director

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